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April 1st, 2010
Renesas Electronics Corporation

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Flash Development Toolkit
Method for Using the User Program Mode (SH7086 Application)

Summary

This application note describes how to use the Flash Development Toolkit from Renesas, and explains how to use the SH7086 (SH family) user program mode using the Flash Development Toolkit, as follows:

- Boot mode 1 (write to the user boot area)
- Boot mode 2 (write to the user area)
- User boot mode
- User program mode

From the explanation given here, please understand the differences between the boot mode, user boot mode and user program mode, and learn how to use the user program mode.

In this application note, an explanation is made of a file created for use in user program mode. This file processes a write to and erase of the internal flash memory that is used in both user program mode and user boot mode in common. When writing to and erasing the flash memory in user program mode or user boot mode, refer to this file for user program mode.

In this document, we’ll use Flash Development Toolkit 4.01.

Table of Contents

1. SH7086

1.1 Flash Memory Configuration

The flash memory of the SH7086 (SH family) has two types of memory mats: a user mat (user area) and a user boot mat (user boot area).

In addition to these, there is another area in which the flash memory write/erase control program is stored. This area is referred to as the boot mat (boot area). In this application note, they are referred to as the boot area, user area and user boot area, respectively.

Area	Type	Size	Block(s)
User area	Flash memory	512 Kbytes	16 blocks Eight 4-Kbyte blocks One 32-Kbyte block Seven 64-Kbyte blocks
User boot area	Flash memory	8 Kbytes	1 block
Boot area	Control program	-	-

1.2 Operation Modes

The SH7086 has 8 kinds of operation modes (modes 0–7). Which mode is selected depends on how the FWE pin and the mode pins (MD1, MD0) are set.

Modes 0–2 are external extension modes in which external memory and peripheral devices can be accessed.

Modes 2, 5 and 6 permit an external address space to be set up from one area to another by the bus controller after program execution started.

Mode 3 is a single-chip startup extension mode in which the access to external memory or peripheral device can be switched over when program execution starts.

Modes 4–7 respectively are boot mode, user boot mode and user program mode in which the flash memory can be written to and erased.

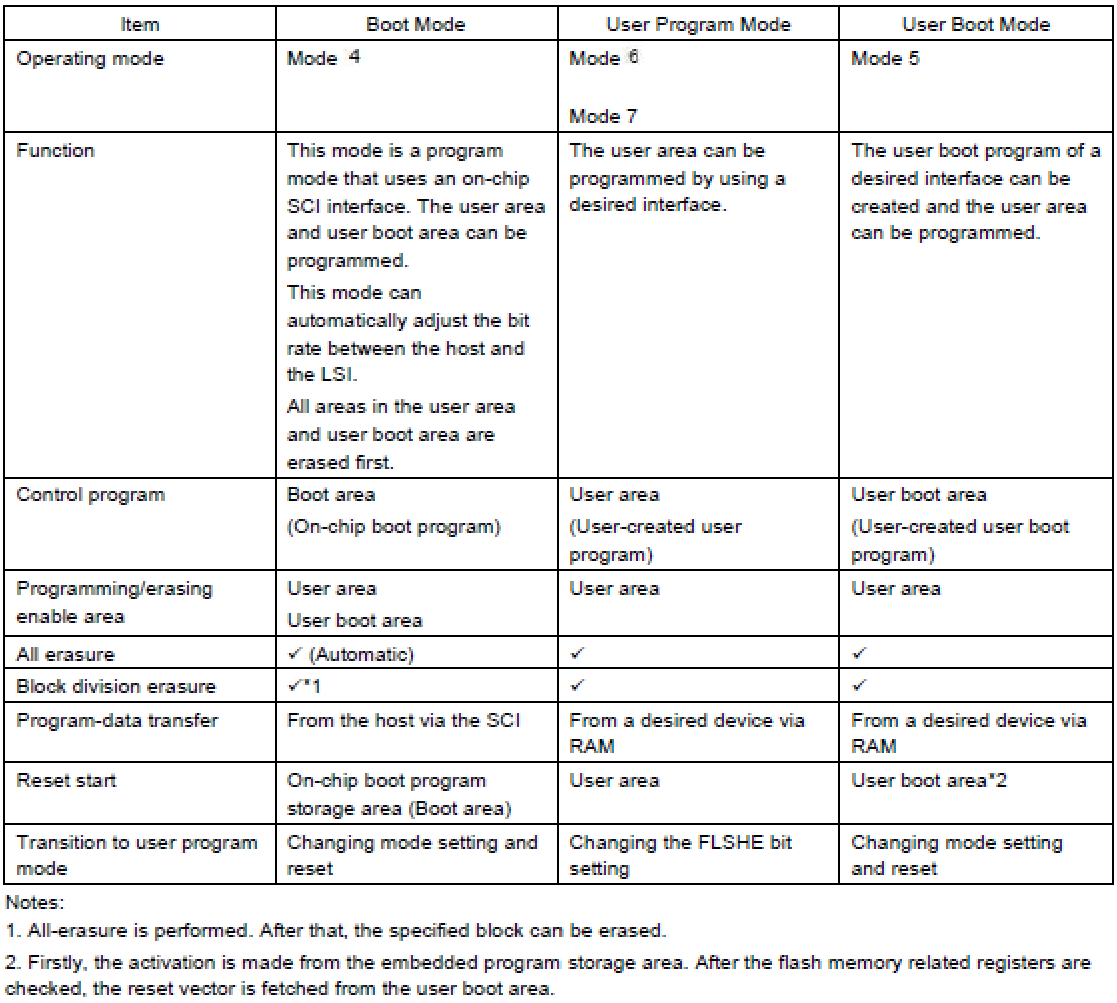
Be sure that the FWE pin and the mode pins (MD1, MD0) do not change state while the LSI is in operation.

For details, see the hardware manual.

	Pin Setting					Bus Width of CS0 Space			
Mode No.	FWE	MD1	MD0	Mode Name	On-Chip ROM	SH7083	SH7084	SH7085	SH7086
Mode 0	0	0	0	MCU extension mode 0	Not active	8	8	16	16
Mode 1	0	0	1	MCU extension mode 1	Not active	16	16	32	32
Mode 2	0	1	0	MCU extension mode 2	Active	Set by CS0BCR in BSC			
Mode 3	0	1	1	Single chip mode	Active	—			
Mode 4*	1	0	0	Boot mode	Active	—			
Mode 5*	1	0	1	User boot mode	Active	Set by CS0BCR in BSC			
Mode 6*	1	1	0	User programming mode	Active	Set by CS0BCR in BSC			
Mode 7*	1	1	1			—			

1.3 On-board Programming Mode

There are three on-board programming modes: boot mode, user program mode and user boot mode.



Item	Boot Mode	User Program Mode	User Boot Mode
Operating mode	Mode 4	Mode 6 Mode 7	Mode 5
Function	This mode is a program mode that uses an on-chip SCI interface. The user area and user boot area can be programmed. This mode can automatically adjust the bit rate between the host and the LSI. All areas in the user area and user boot area are erased first.	The user area can be programmed by using a desired interface.	The user boot program of a desired interface can be created and the user area can be programmed.
Control program	Boot area (On-chip boot program)	User area (User-created user program)	User boot area (User-created user boot program)
Programming/erasing enable area	User area User boot area	User area	User area
All erasure	✓ (Automatic)	✓	✓
Block division erasure	✓*1	✓	✓
Program-data transfer	From the host via the SCI	From a desired device via RAM	From a desired device via RAM
Reset start	On-chip boot program storage area (Boot area)	User area	User boot area*2
Transition to user program mode	Changing mode setting and reset	Changing the FLSHE bit setting	Changing mode setting and reset

Notes:

1. All-erasure is performed. After that, the specified block can be erased.

2. Firstly, the activation is made from the embedded program storage area. After the flash memory related registers are checked, the reset vector is fetched from the user boot area.

The user boot area can be written to and erased in only boot mode.
In boot mode, the user area and user boot area are once erased in their entirety.
After that, the user area or user boot area can be written to by issuing a command, but their contents cannot be read out up until this state.
The programming modes may be used in various ways. For example, you might want to write to the user boot area only and then rewrite the user area in user boot mode, or rewrite the user area only because the user boot mode is unused.
In user boot mode, a boot operation of any desired interface can be realized by setting up the mode pins differently than in user program mode.

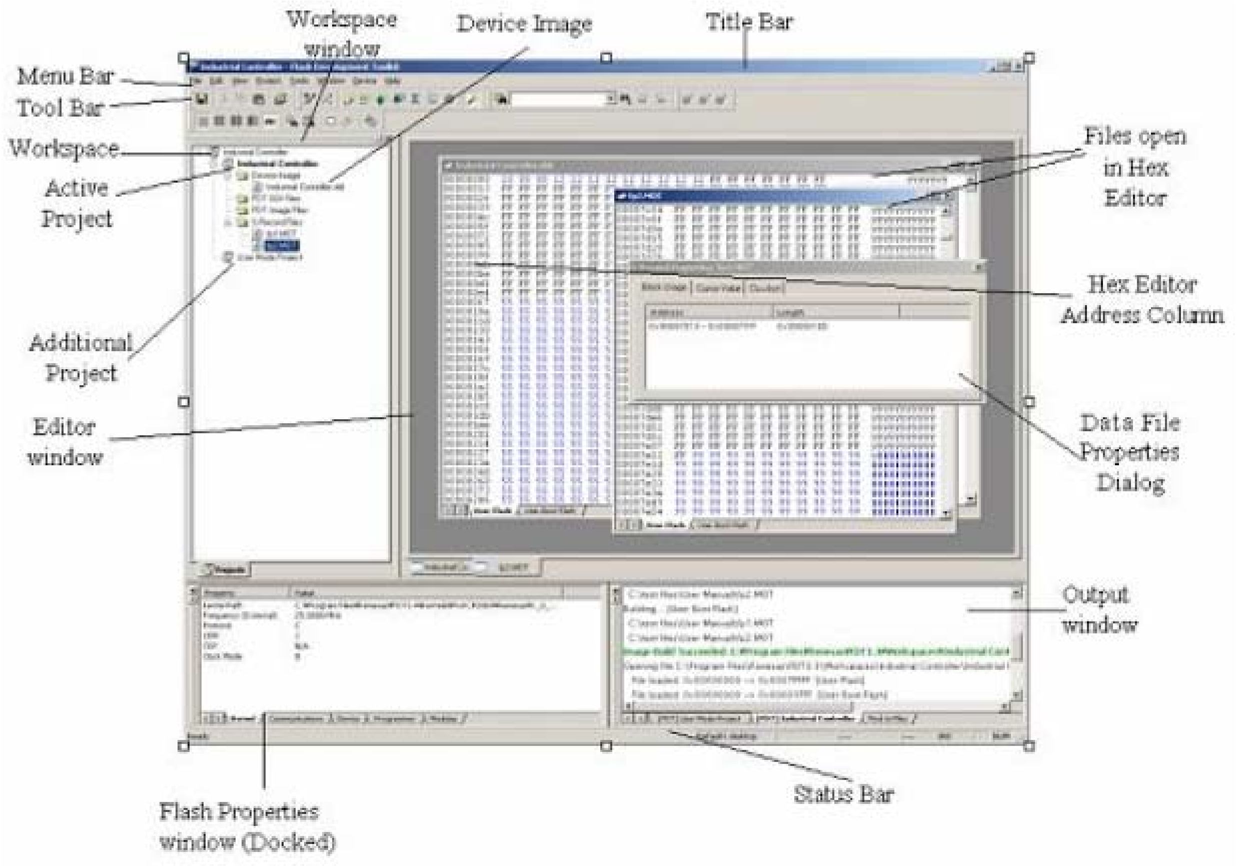
2. Functionality of the Flash Development Toolkit

The Flash Development Toolkit is an on-board flash programming tool for Renesas flash microcomputers, featuring a highly functional, easy to use graphical user interface.
The Flash Development Toolkit, when used in combination with the High-performance Embedded Workshop from Renesas, provides the developers of built-in software using Renesas flash microcomputers with an integrated development environment. Furthermore, the Flash Development Toolkit may also be used as an editor of general-purpose S record format or hexadecimal files.

2.1 Main Facilities

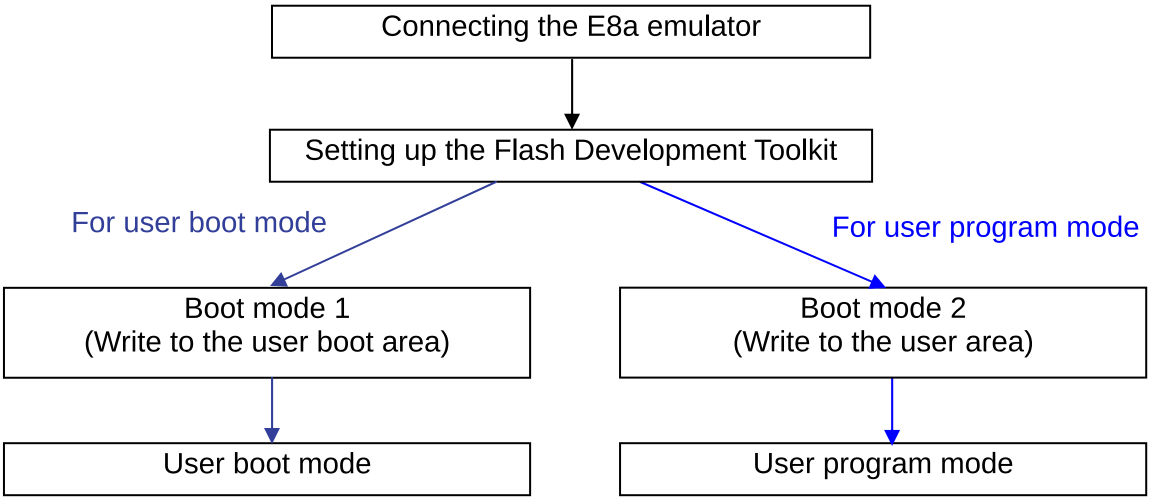
- Connection with a device: Connects a device to the Flash Development Toolkit interface.
- Disconnection of a device: Disconnects a device from the Flash Development Toolkit interface.
- Block erase: Erases a specific block or the entire block of a device's flash memory from the Block Erase dialog box it opens.
- Blank check: Checks whether the flash part of the target device is blank or not.
- Upload: Uploads data from the target device.
- Target file download: Downloads the file active in a hexadecimal editor.
- Flash checksum: Returns a checksum of flash memory data.
- Flash area specification: Sets a flash area subject to non-programming operations (e.g., upload and blank check).
- Other: The Flash Development Toolkit has an easy to operate simple interface mode and a basic simple interface mode.

For details, see the "Renesas Flash Development Toolkit 4.01 User's Manual."



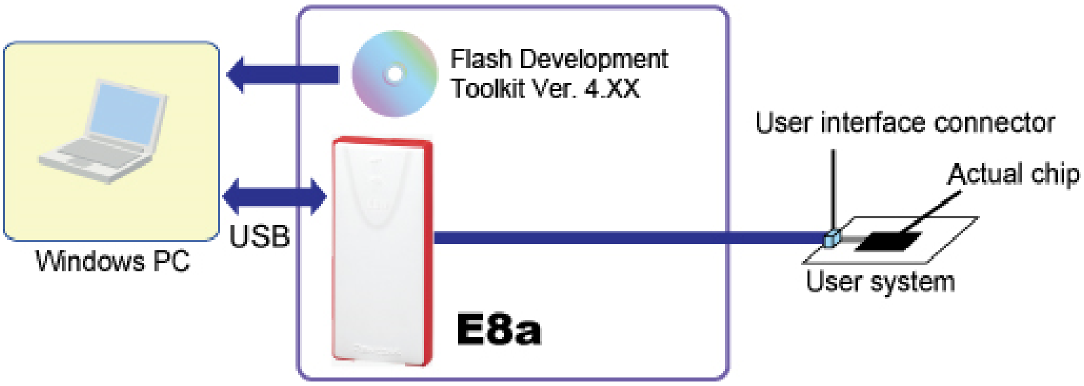
3. Method for Using the Flash Development Toolkit in Each Mode

For a write to the user boot area in user boot mode or a write to the user area in user program mode to be executed, there must be the load module file for user program mode (shared with user boot mode) written in the area concerned.
In this document, we first explain how to write the load module file for user program mode to the user boot area or user area in boot mode, and then explain how the user boot mode and user program mode works. The procedure is shown below.



3.1 Connecting the E8a Emulator

The E8a emulator, connected between the host computer and user system, has the facility to write the user application program to or erase the program written in a flash microcomputer's internal flash memory on the user system (on-board) by using the Flash Development Toolkit.

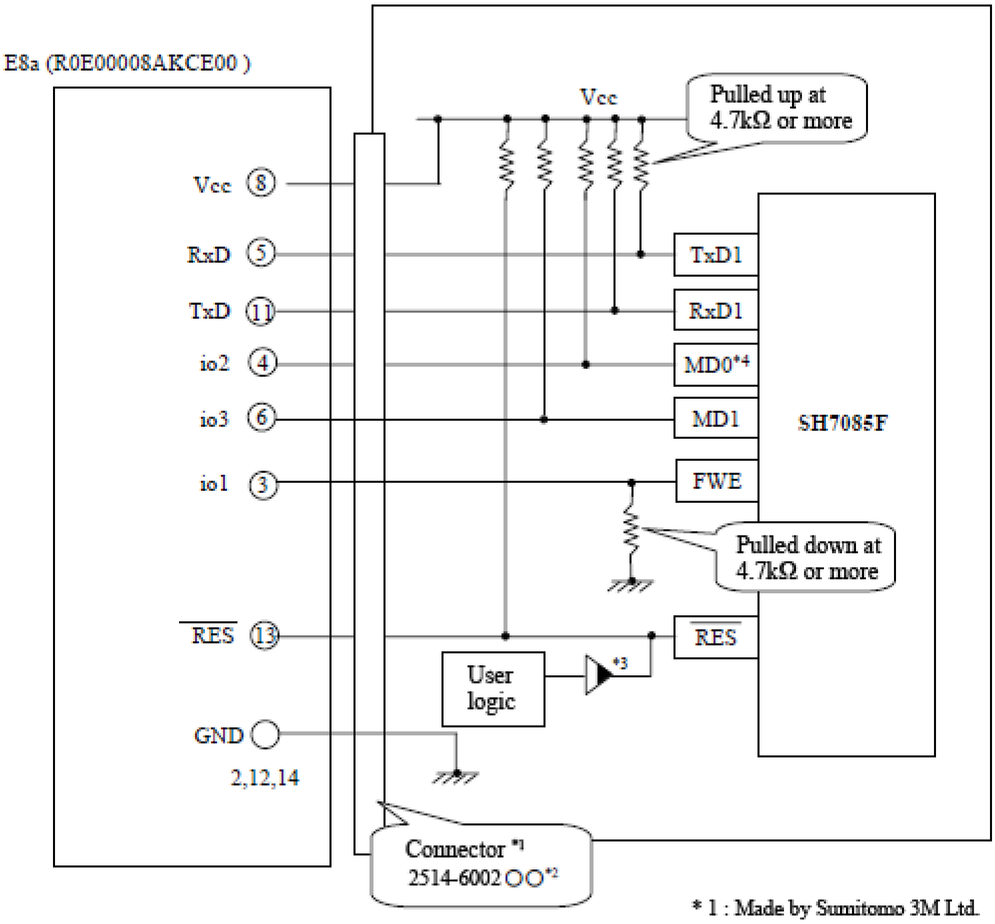


The relationship between the pin numbers and pin names of the E8a emulator and the pin settings of the Flash Development Toolkit is shown below.

Pin No.	E8a Pin Name	Pin Setteing of Flash Development Toolkit
1	io0 / CLK	D
2	GND	-
3	io1	C
4	io2	A
5	RxD (User side: TxD)	-
6	io3	E
7	Io4/SIO	B
8	UVcc	-
9	UVcc2	-
10	Io6	F
11	TxD (User side: RxD)	-
12	GND	-
13	/RES	-
14	GND	-

[Note] Always be sure that the pins 2, 8, 12, 13 and 14 are connected.

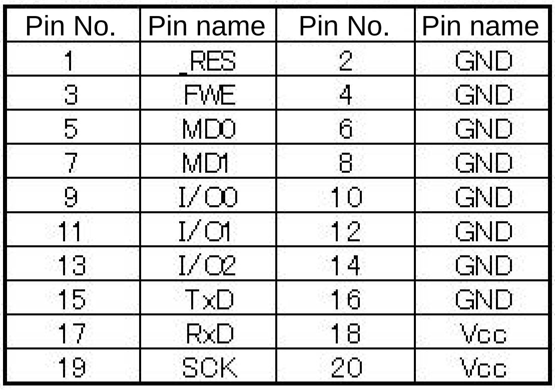
An example of a connection between the E8a emulator and the SH7068 is shown below. The pullup and pulldown resistance values are given for reference purposes only. These values need to be evaluated in your system before they are actually used.



* 1 : Made by Sumitomo 3M Ltd.
* 2 : ○○ shows plated parts
* 3 : Open-collector buffer
* 4: According to the orerating mode, change it to be pulled down.

In this application note, we use the CPU board “HSB70865F” made by Hokuto Denshi Co., Ltd. as the SH7086 user system. For details, refer to the URL of Hokuto Denshi Co., which is given below.
http://www.hokutodenshi.co.jp/

The relationship between the pin numbers and the pin names of the HSB70865F is shown below.

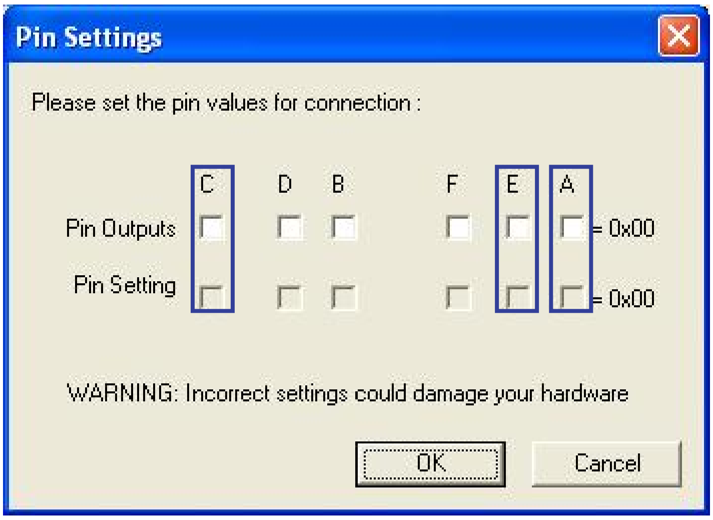


Pin No.	Pin name	Pin No.	Pin name
1	_RES	2	GND
3	FWE	4	GND
5	MD0	6	GND
7	MD1	8	GND
9	I/O0	10	GND
11	I/O1	12	GND
13	I/O2	14	GND
15	TxD	16	GND
17	RxD	18	Vcc
19	SCK	20	Vcc

Since the E8a emulator and the HSB70865F connect to external devices via 14 pins and 20 pins, respectively, the 14 ↔ 20-pin conversion connector "FDM-E8a" made by Hokuto Denshi is used in this document. For details, refer to the URL of Hokuto Denshi Co., which is given below.
http://www.hokutodenshi.co.jp/
The pin conversion table of the FDM-E8a is shown below.

20 pins (HSB70865F pin names)	14 pins (FDT pin settings)
1 pin （_RES）	13 pin
2,4,6,8,10,12,14,16 pin（GND）	2,12,14 pin
15 pin（TxD）	5 pin
17 pin（RxD）	11 pin
18 pin（Vcc）	8 pin
20 pin（Vcc）	9 pin
3 pin （FWE）	3 pin （C）
5 pin （MD0）	4 pin （A）
7 pin （MD1）	6 pin （E）
9 pin （I/O0）	7 pin （B）
11 pin（I/O1）	10 pin（F）
13 pin（I/O2）	–
19 pin（SCK）	1 pin （D）

To use the Flash Development Toolkit with the SH7086, it is necessary to set up the FWE pin and the MD1 and MD0 pins.
In this application note, we set pin C (FWE), pin E (MD1) and pin A (MD0) in the pin setting phase of the Flash Development Toolkit.


Pin Settings

Please set the pin values for connection :

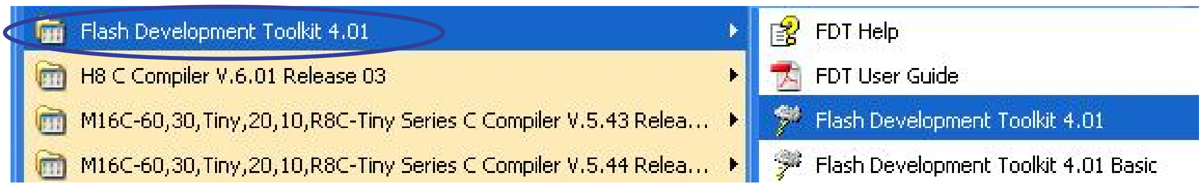
	C	D	B	F	E	A	
Pin Outputs	□	□	□	□	□	□	= 0x00
Pin Setting	□	□	□	□	□	□	= 0x00

WARNING: Incorrect settings could damage your hardware

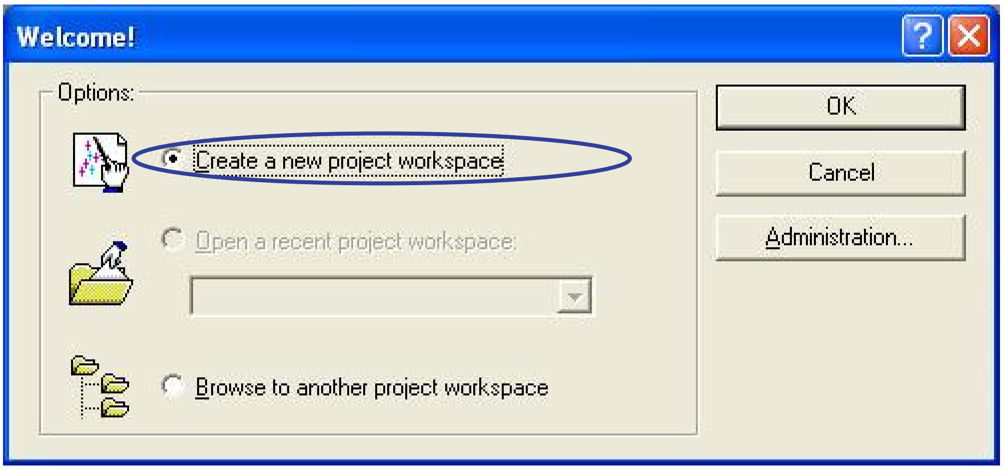
3.2 Setting Up the Flash Development Toolkit

Before writing a program to the flash memory, first set up the Flash Development Toolkit.

(1) Start the Flash Development Toolkit.
From All Programs, choose “Flash Development Toolkit 4.01.”


Flash Development Toolkit 4.01
H8 C Compiler V.6.01 Release 03
M16C-60,30,Tiny,20,10,R8C-Tiny Series C Compiler V.5.43 Relea...
M16C-60,30,Tiny,20,10,R8C-Tiny Series C Compiler V.5.44 Relea...
FDT Help
FDT User Guide
Flash Development Toolkit 4.01
Flash Development Toolkit 4.01 Basic

(2) The Welcome! screen of the Flash Development Toolkit will be displayed.
Select the “Create New Project Workspace” radio button and click OK.
From the next time on, because the previously selected device and port information are retained, select “Open Recently Used Project Workspace” and click OK.


Welcome!

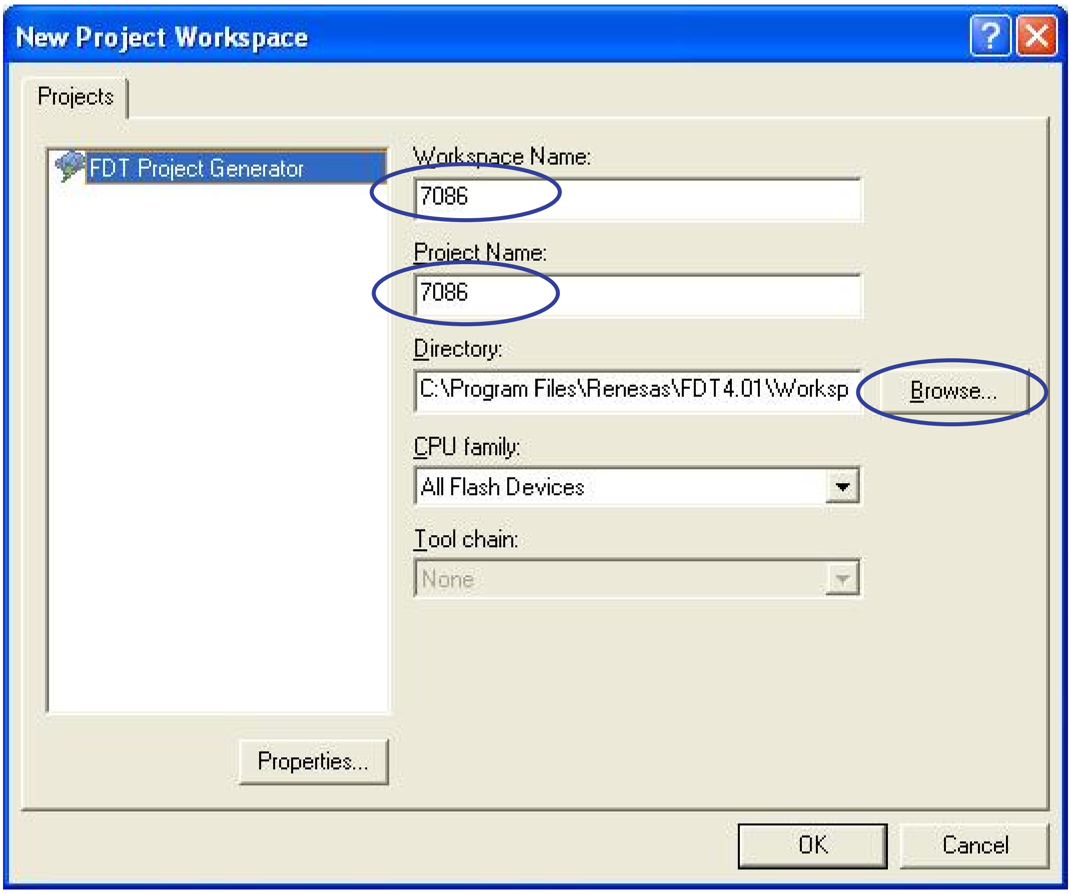
Options:

● Create a new project workspace

○ Open a recent project workspace:

○ Browse to another project workspace

(3) Set up a new project workspace.
First, specify a workspace name and a project name.
Here, use the same name to specify a workspace name and a project name.
Choose "Browse," and from the ensuing list select the location in which you want to save the workspace.
When you've completed the dialog box, click OK.



Workspace Name: 7086

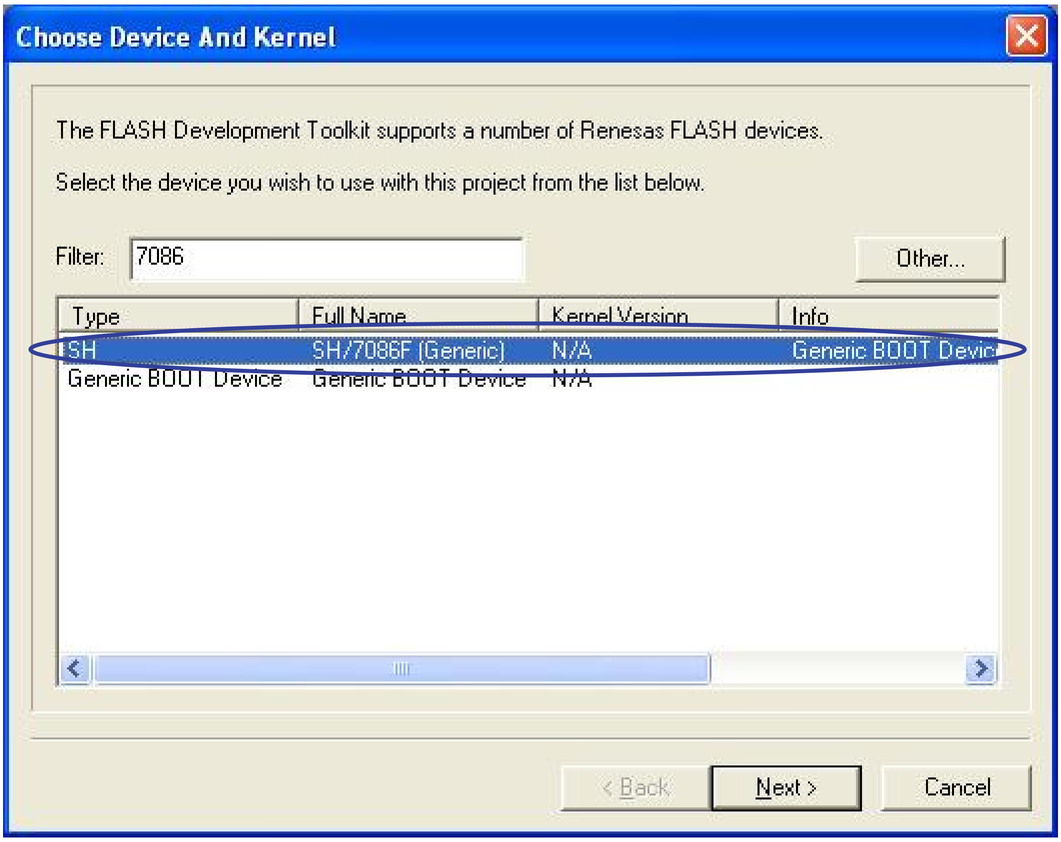
Project Name: 7086

Directory: C:\Program Files\Renesas\FDT4.01\Worksp

CPU family: All Flash Devices

Tool chain: None

(4) Select the target device.
Select “SH/7086F (Generic)” and click Next.



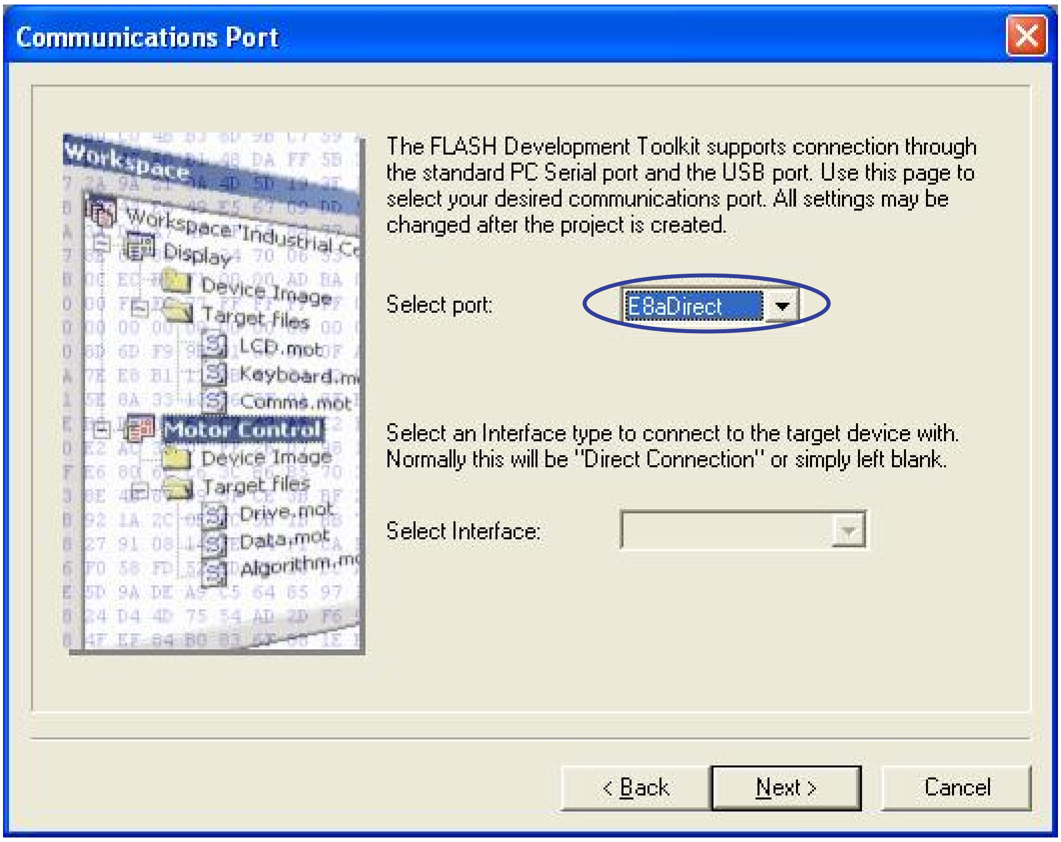
The FLASH Development Toolkit supports a number of Renesas FLASH devices.

Select the device you wish to use with this project from the list below.

Filter: 7086

Type	Full Name	Kernel Version	Info
SH	SH/7086F (Generic)	N/A	Generic BOOT Devic
Generic BOOT Device	Generic BOOT Device	N/A	

(5) Select a communication port.
From the pulldown menu, choose “E8aDirect” and click Next.



Communications Port

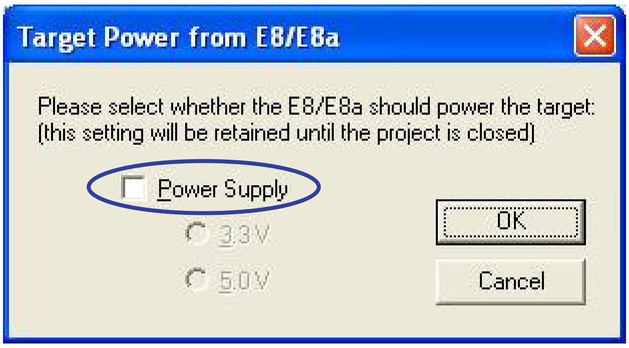
The FLASH Development Toolkit supports connection through the standard PC Serial port and the USB port. Use this page to select your desired communications port. All settings may be changed after the project is created.

Select port: E8aDirect

Select an Interface type to connect to the target device with. Normally this will be "Direct Connection" or simply left blank.

Select Interface:

(6) Set up power supply.
Simply click OK leaving the Power Supply check box unselected.



Target Power from E8/E8a

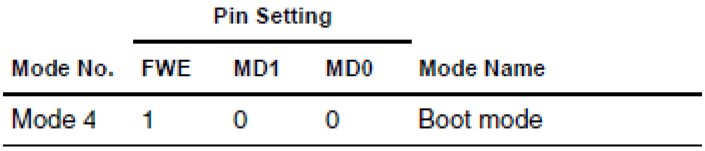
Please select whether the E8/E8a should power the target:
(this setting will be retained until the project is closed)

□ Power Supply

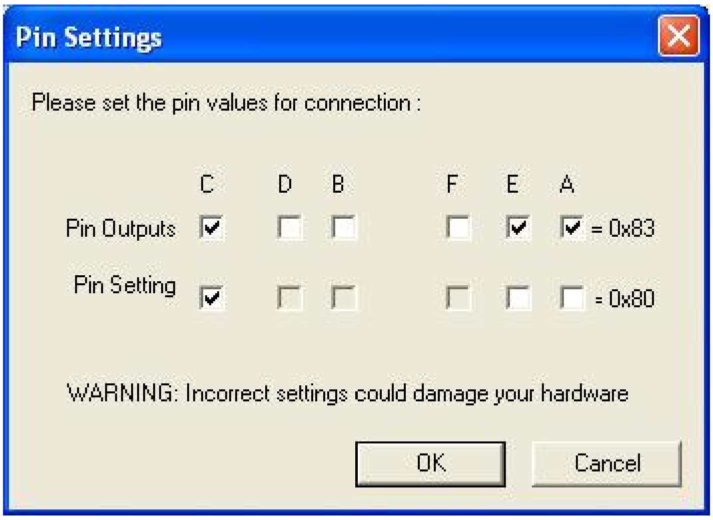
○ 3.3 V

○ 5.0 V

(7) Set up the E8a pins for boot mode.
Set pin C (FWE) to 1 and pin E (MD1) and pin A (MD0) to 0, respectively and then click OK.



	Pin Setting			
Mode No.	FWE	MD1	MD0	Mode Name
Mode 4	1	0	0	Boot mode



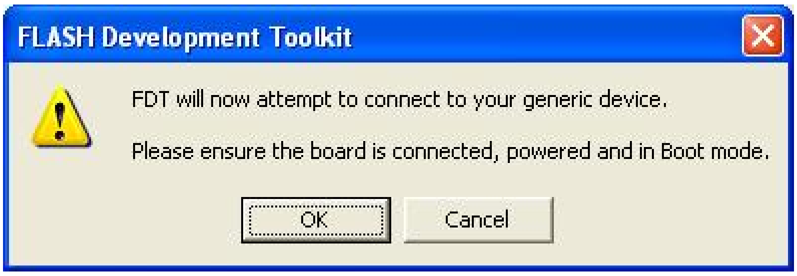
Pin Settings

Please set the pin values for connection :

	C	D	B	F	E	A	
Pin Outputs	☑	□	□	□	☑	☑	= 0x83
Pin Setting	☑	□	□	□	□	□	= 0x80

WARNING: Incorrect settings could damage your hardware

When a connection is complete, click OK.

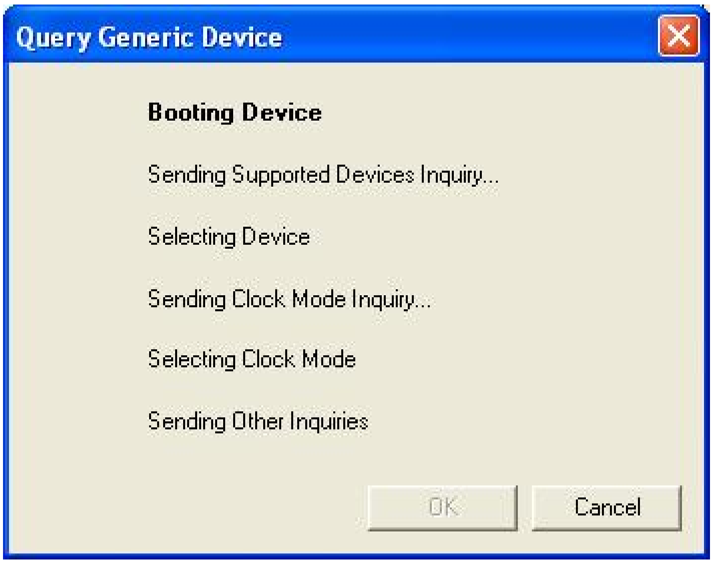


FLASH Development Toolkit

FDT will now attempt to connect to your generic device.

Please ensure the board is connected, powered and in Boot mode.

(8) Check the device for confirmation.



Query Generic Device

Booting Device

Sending Supported Devices Inquiry...

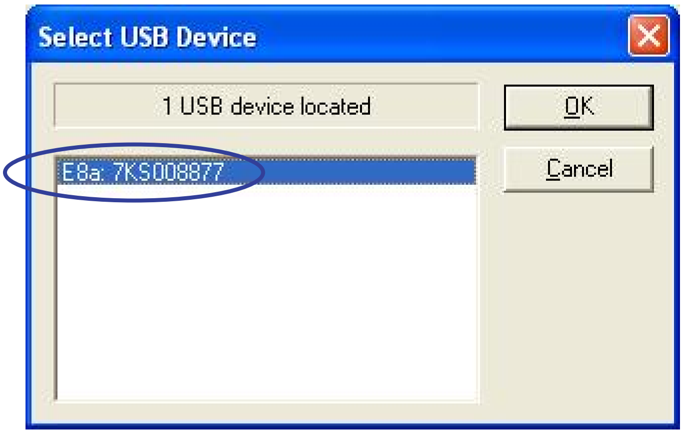
Selecting Device

Sending Clock Mode Inquiry...

Selecting Clock Mode

Sending Other Inquiries

Select the E8a and click OK.

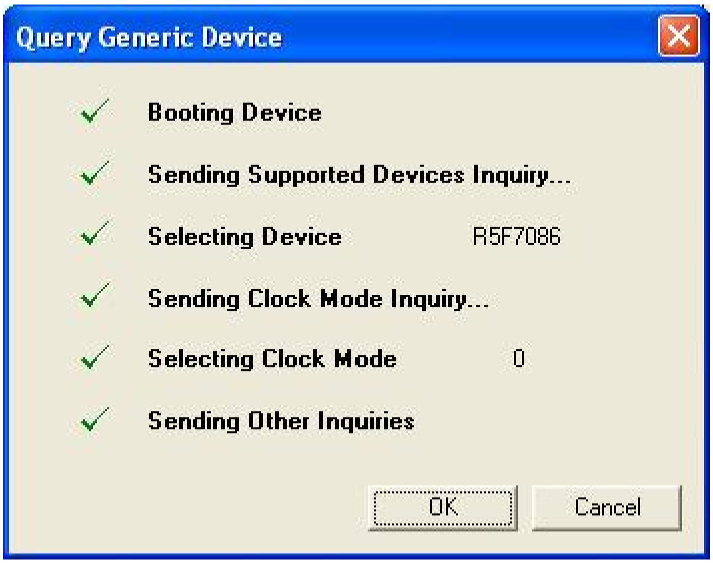


Select USB Device

1 USB device located

E8a: 7KS008877

Device confirmation is complete. Click OK.



Query Generic Device

✓ **Booting Device**

✓ **Sending Supported Devices Inquiry...**

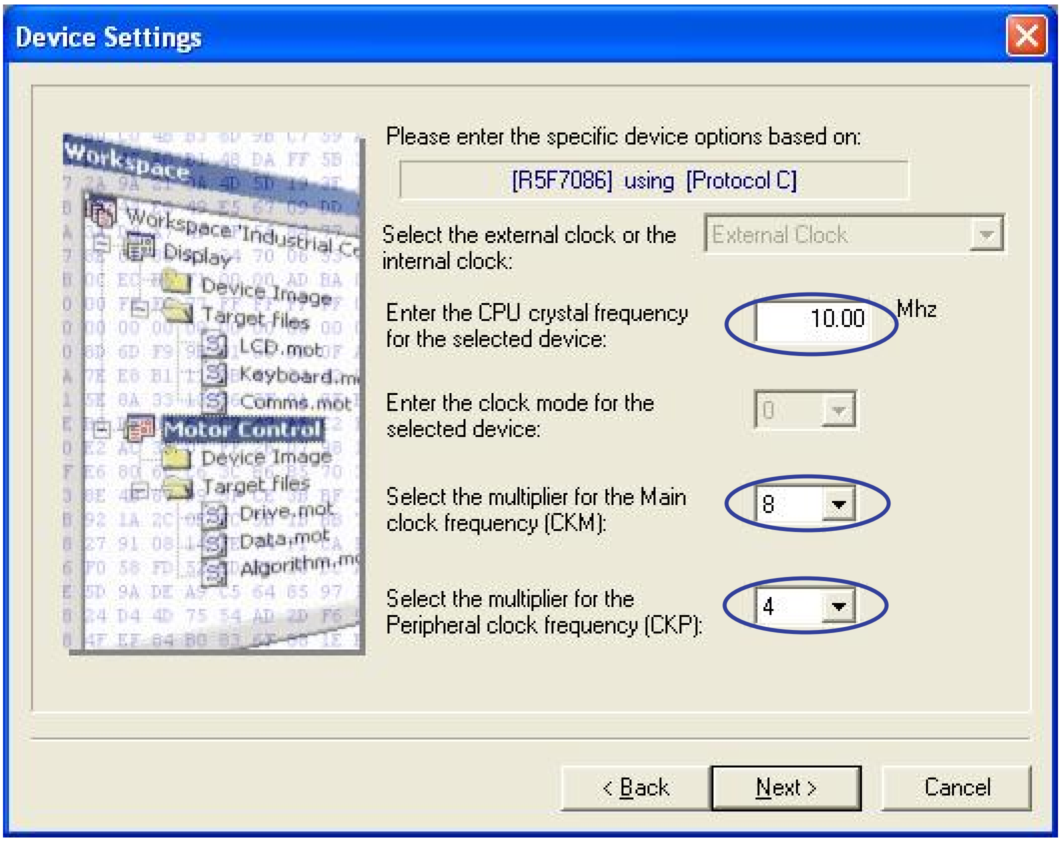
✓ **Selecting Device** R5F7086

✓ **Sending Clock Mode Inquiry...**

✓ **Selecting Clock Mode** 0

✓ **Sending Other Inquiries**

(9) Set up the device.
For Input Clock, enter the clock frequency used in the board in MHz units.
Enter 10.00 MHz.
Set 8 for Main Clock Multiply Factor and 4 for Peripheral Clock Multiply Factor, and then click Next.



Device Settings

Please enter the specific device options based on:

[R5F7086] using [Protocol C]

Select the external clock or the internal clock: External Clock

Enter the CPU crystal frequency for the selected device: 10.00 Mhz

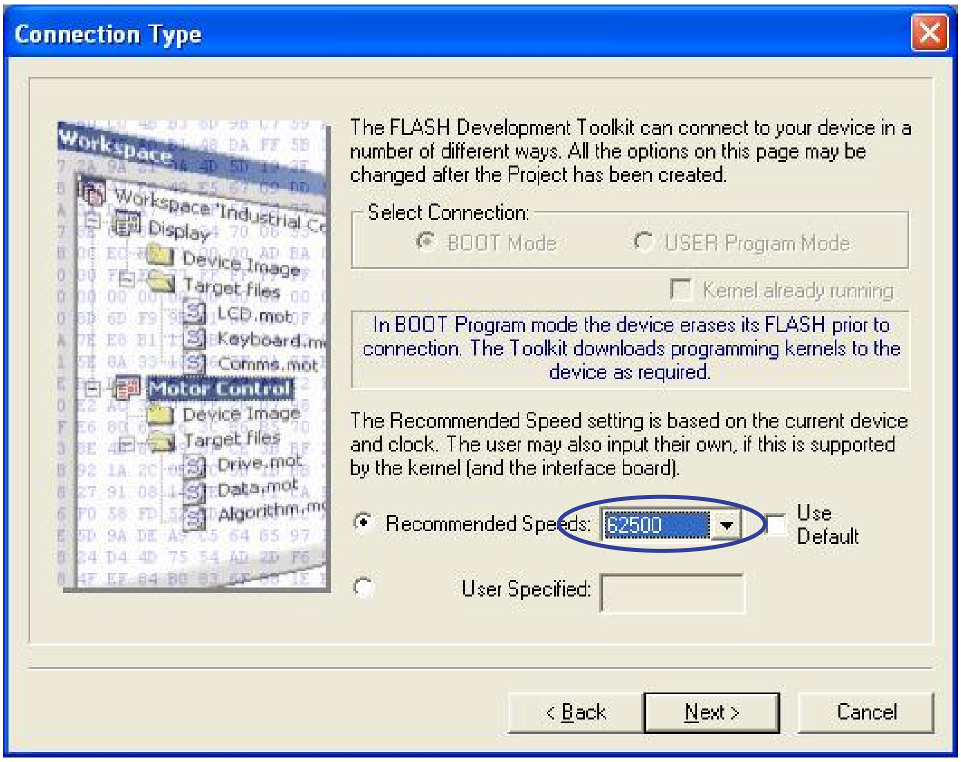
Enter the clock mode for the selected device: 0

Select the multiplier for the Main clock frequency (CKM): 8

Select the multiplier for the Peripheral clock frequency (CKP): 4

The input clock here refers to the clock frequency that is directly fed to the microcomputer. Enter the frequency of the quartz crystal resonator or ceramic resonator connected to the user system. The input clock frequency and the operating clock frequency (PLL output) differ.

(10) Set up the type of connection.
From the pulldown menu, set the baud rate.
Select “625000” and click Next.



Connection Type

The FLASH Development Toolkit can connect to your device in a number of different ways. All the options on this page may be changed after the Project has been created.

Select Connection: ● BOOT Mode ○ USER Program Mode

□ Kernel already running

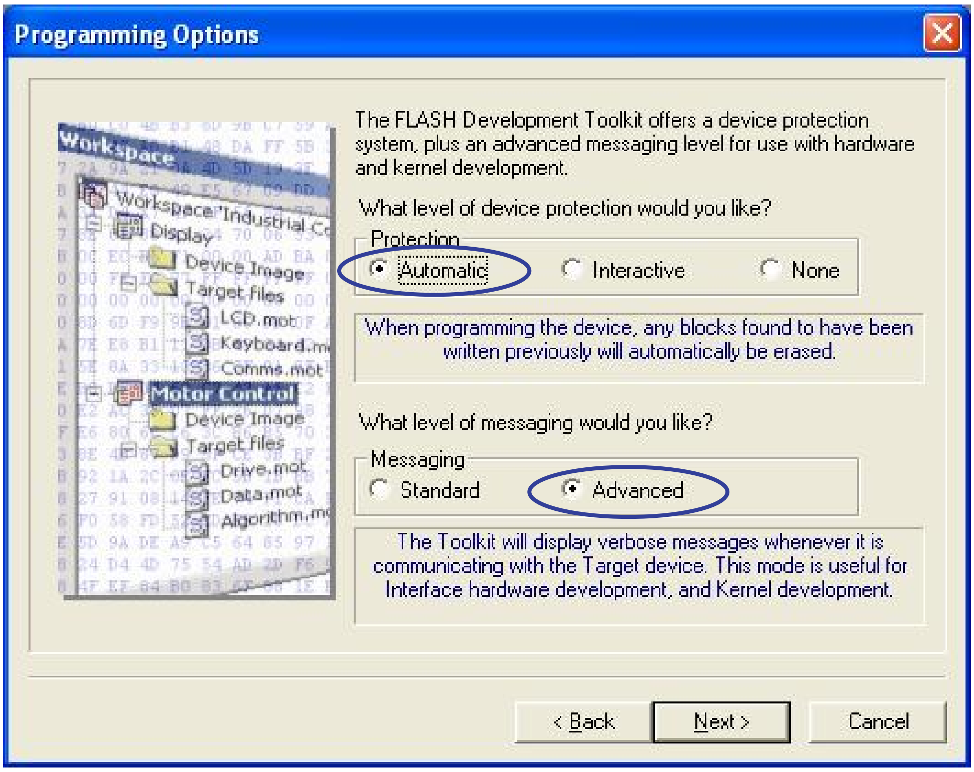
In BOOT Program mode the device erases its FLASH prior to connection. The Toolkit downloads programming kernels to the device as required.

The Recommended Speed setting is based on the current device and clock. The user may also input their own, if this is supported by the kernel (and the interface board).

● Recommended Speeds: 62500 □ Use Default

○ User Specified:

(11) Select write options.
Select “Automatic” for Protection Level and “Advanced” for Output Message Level, and then click Next.



Programming Options

The FLASH Development Toolkit offers a device protection system, plus an advanced messaging level for use with hardware and kernel development.

What level of device protection would you like?

Protection: ● Automatic ○ Interactive ○ None

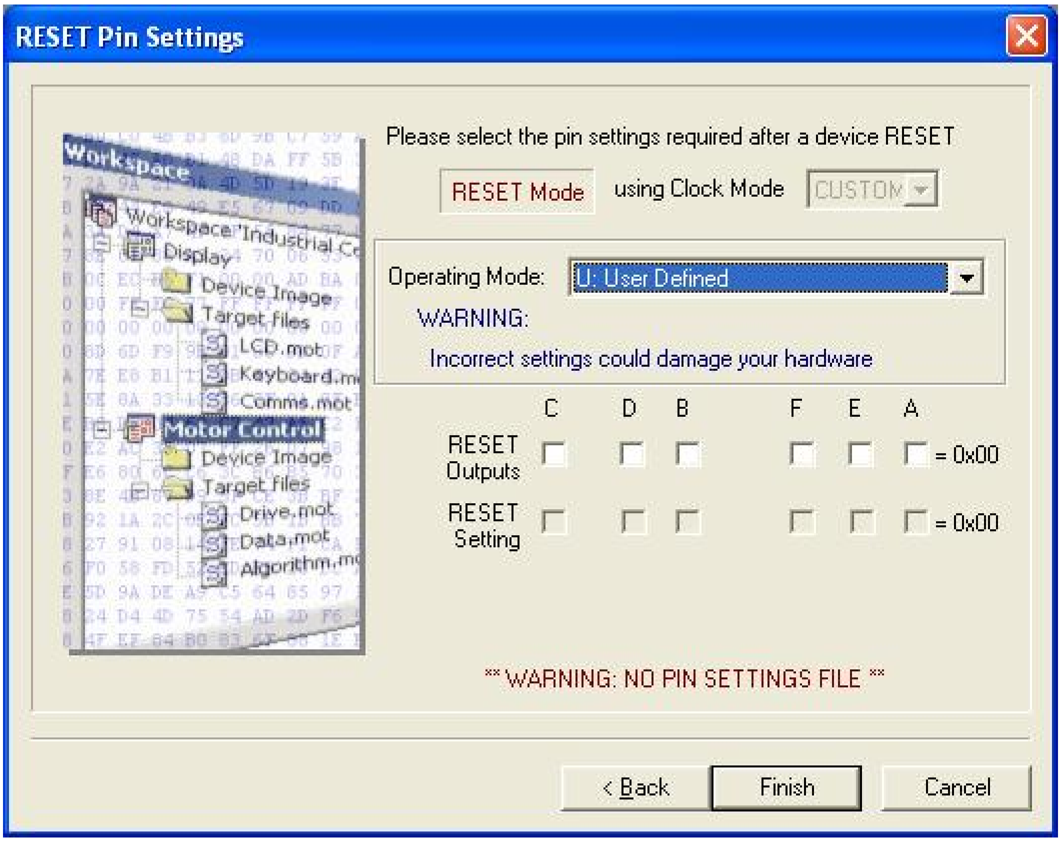
When programming the device, any blocks found to have been written previously will automatically be erased.

What level of messaging would you like?

Messaging: ○ Standard ● Advanced

The Toolkit will display verbose messages whenever it is communicating with the Target device. This mode is useful for Interface hardware development, and Kernel development.

(12) Set the E8a pins as required when the device restarts in reset mode.
Since there is no need to set here, simply click Finish.



RESET Pin Settings

Please select the pin settings required after a device RESET

RESET Mode using Clock Mode CUSTOM

Operating Mode: U: User Defined

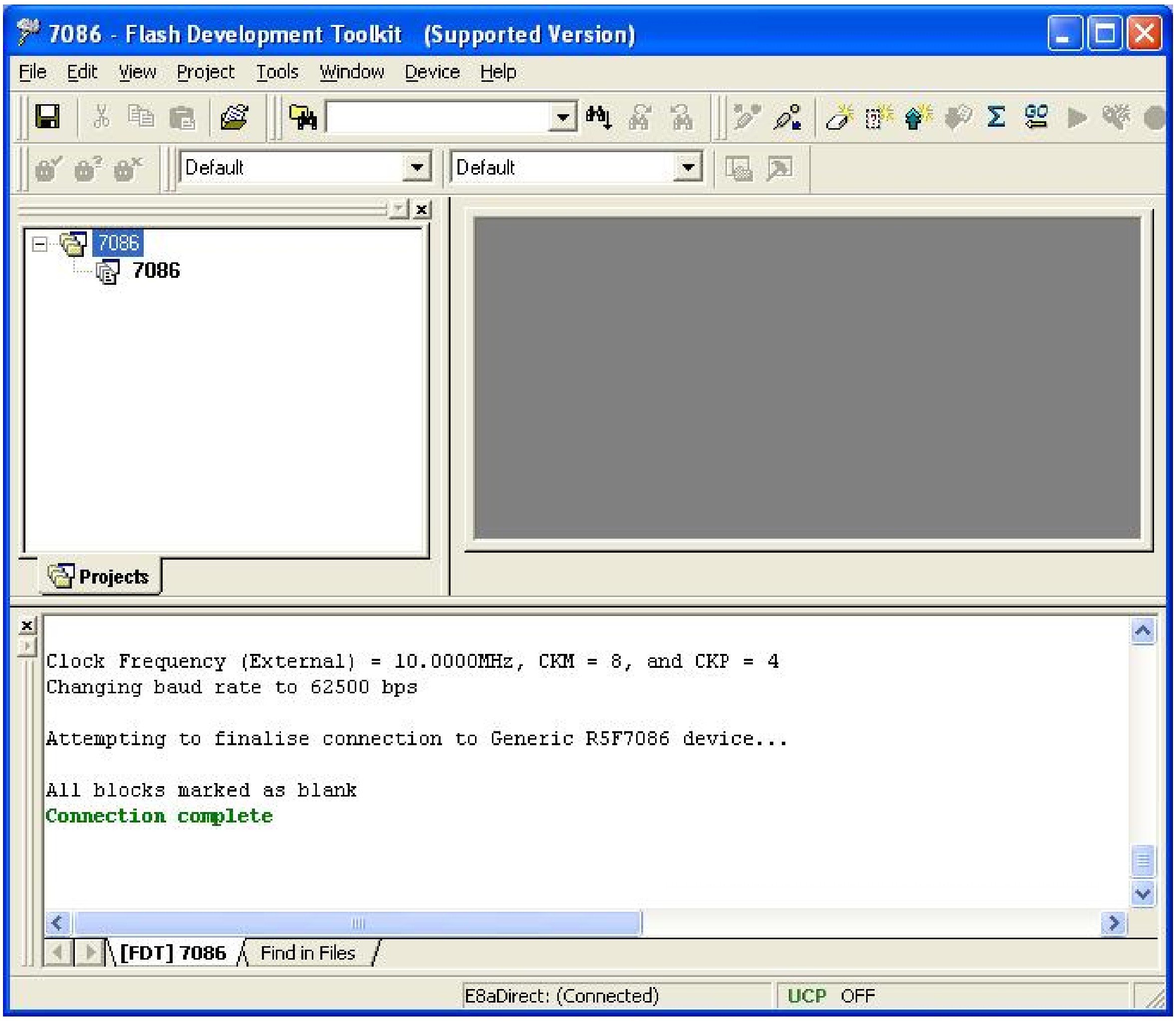
WARNING:

Incorrect settings could damage your hardware

	C	D	B	F	E	A	
RESET Outputs	□	□	□	□	□	□	= 0x00
RESET Setting	□	□	□	□	□	□	= 0x00

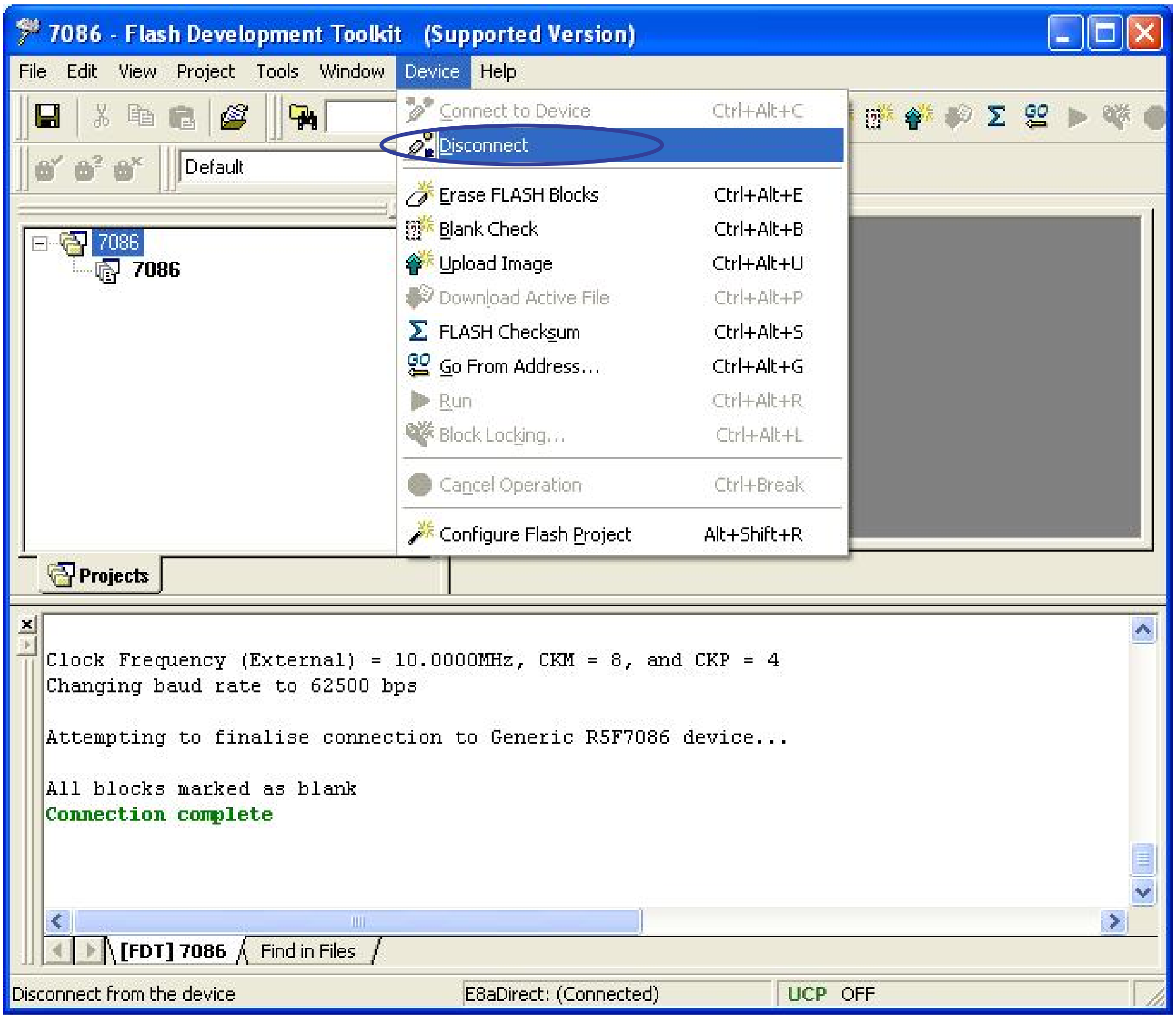
** WARNING: NO PIN SETTINGS FILE **

(13) The SH7086 board will be connected to the Flash Development Toolkit in boot mode.
At this time, the user boot area and user area have had their contents erased.


7086 - Flash Development Toolkit (Supported Version)
File Edit View Project Tools Window Device Help
Default
Default
7086
7086
Projects
[FDT] 7086
Find in Files
E8aDirect: (Connected)
UCP OFF

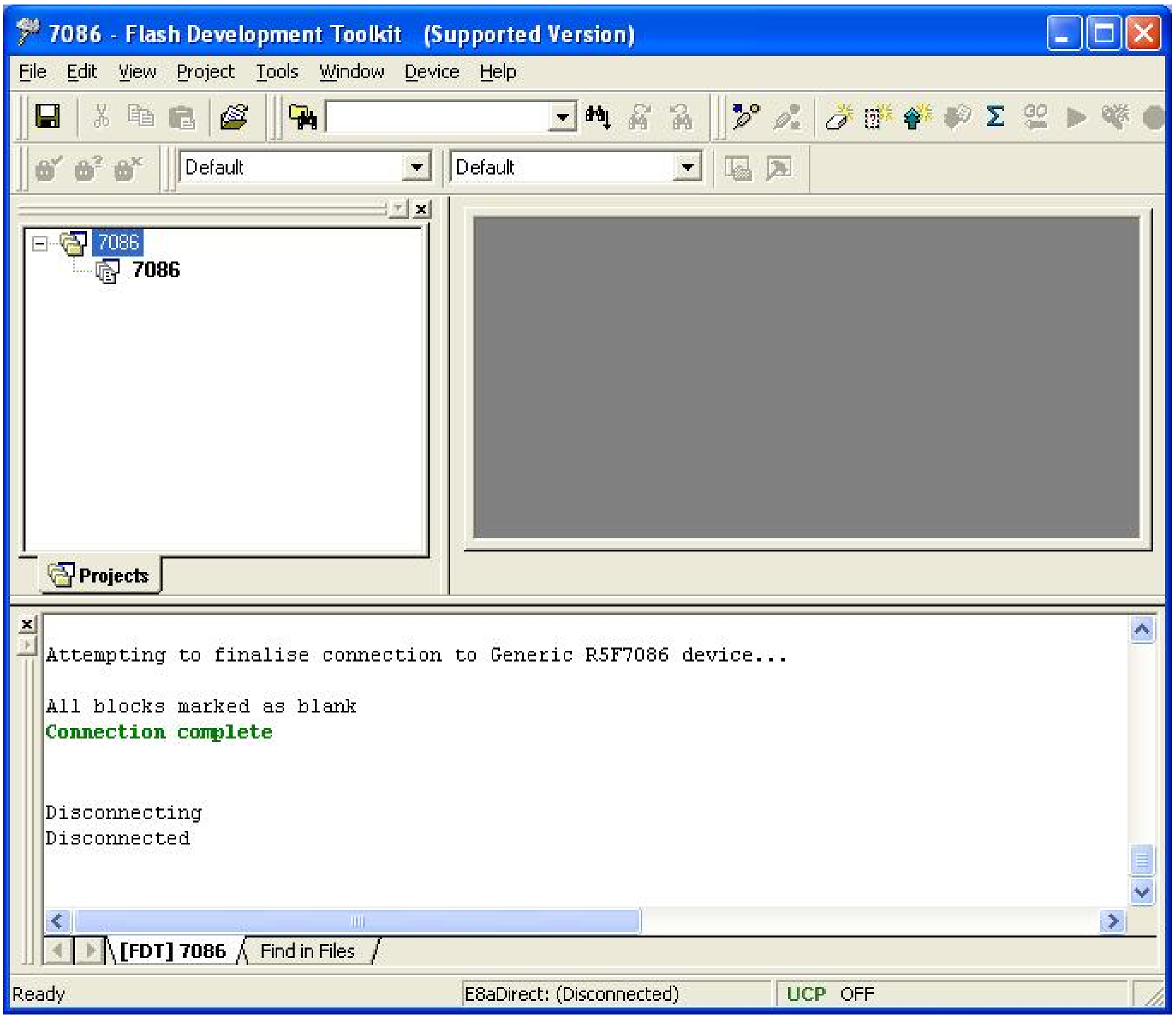
```
Clock Frequency (External) = 10.0000MHz, CKM = 8, and CKP = 4
Changing baud rate to 62500 bps

Attempting to finalise connection to Generic R5F7086 device...

All blocks marked as blank
Connection complete
```

(14) Disconnect the device.
Choose “Disconnect from Device” from the Device menu.


7086 - Flash Development Toolkit (Supported Version)
File Edit View Project Tools Window Device Help
Connect to Device Ctrl+Alt+C
Disconnect
Erase FLASH Blocks Ctrl+Alt+E
Blank Check Ctrl+Alt+B
Upload Image Ctrl+Alt+U
Download Active File Ctrl+Alt+P
FLASH Checksum Ctrl+Alt+S
Go From Address... Ctrl+Alt+G
Run Ctrl+Alt+R
Block Locking... Ctrl+Alt+L
Cancel Operation Ctrl+Break
Configure Flash Project Alt+Shift+R
Default
7086
7086
Projects
[FDT] 7086
Find in Files
Disconnect from the device
E8aDirect: (Connected)
UCP OFF

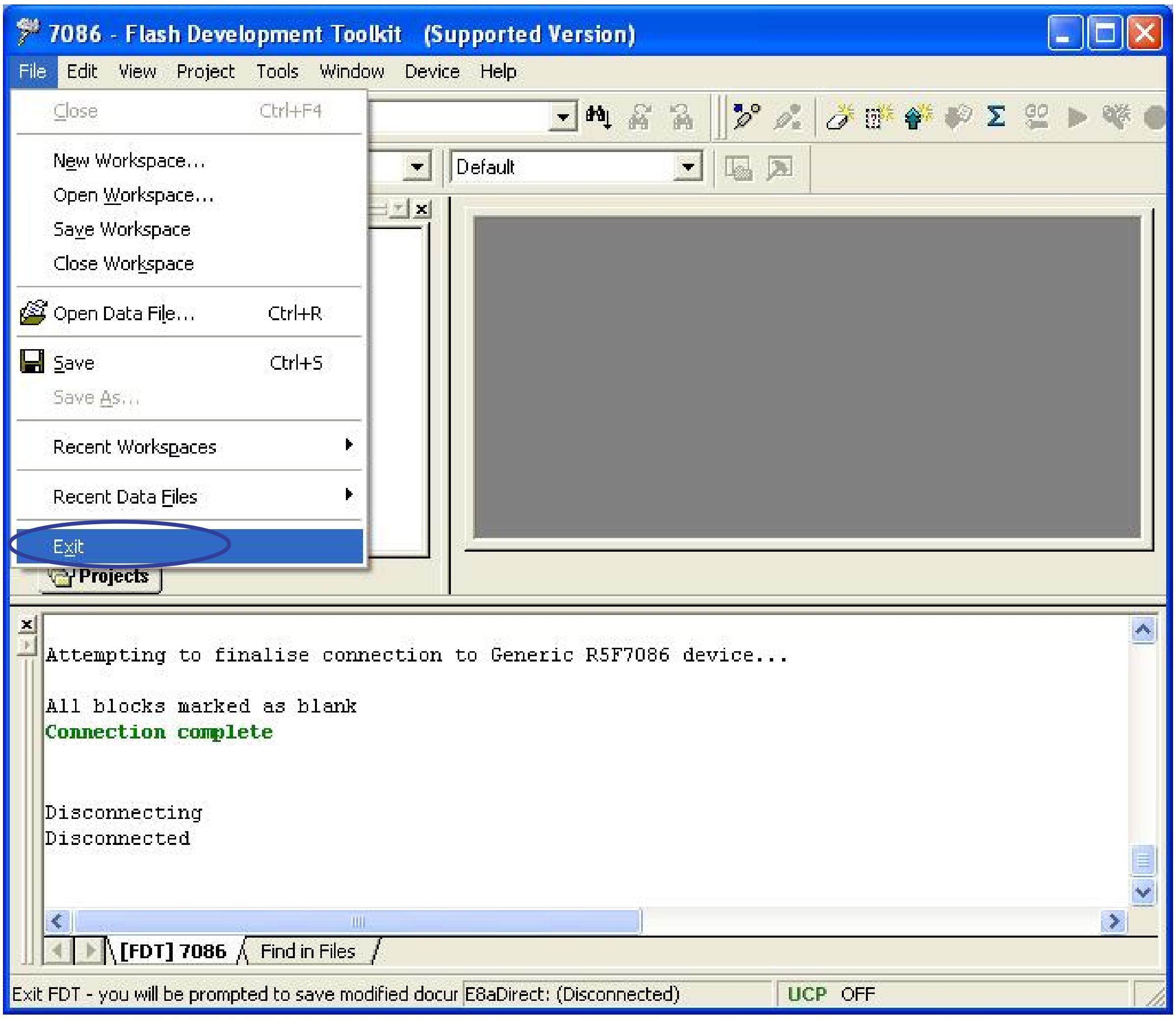
```
Clock Frequency (External) = 10.0000MHz, CKM = 8, and CKP = 4
Changing baud rate to 62500 bps

Attempting to finalise connection to Generic R5F7086 device...

All blocks marked as blank
Connection complete
```

The device will be disconnected.


7086 - Flash Development Toolkit (Supported Version)
File Edit View Project Tools Window Device Help
Default
Default
7086
7086
Projects
[FDT] 7086
Find in Files
Ready
E8aDirect: (Disconnected)
UCP OFF

```
Attempting to finalise connection to Generic R5F7086 device...

All blocks marked as blank
Connection complete


Disconnecting
Disconnected
```

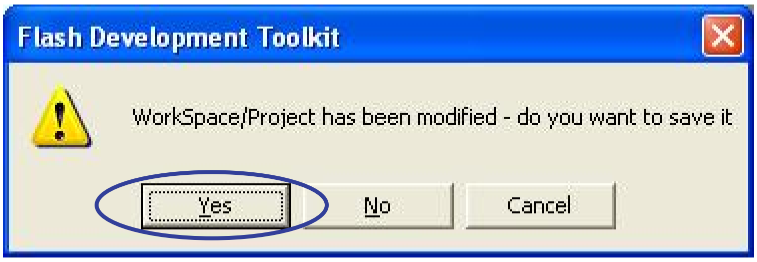
(15) Save the workspace and quit.
Choose “Exit” from the File menu.



```
Attempting to finalise connection to Generic R5F7086 device...

All blocks marked as blank
Connection complete


Disconnecting
Disconnected
```

Exit FDT - you will be prompted to save modified docur E8aDirect: (Disconnected) UCP OFF

Click Yes.



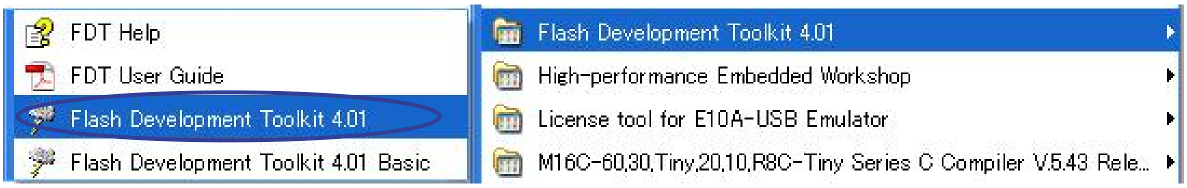
WorkSpace/Project has been modified - do you want to save it

The Flash Development Toolkit will be closed.
The workspace for the Flash Development Toolkit will be saved as 7086.WAS file.

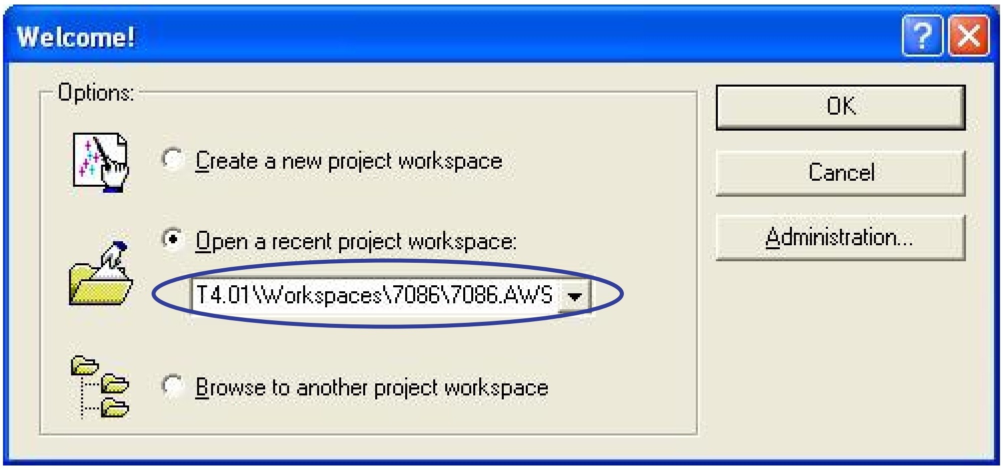
3.3 Boot Mode 1 (Write to the User Boot Area)

Write the load module file for user program mode to the user boot area in boot mode.
The program written to the user boot area is the 7086F.mot file (S type file). Here, use the saved workspace file (7086.AWS) to start.
This program already has the bit rate in it corrected according to the clock frequency. For details about bit rate correction, see paragraph (1), “Setting the bit rate (GenTest.h)” in Section 6.1, “Header File.”

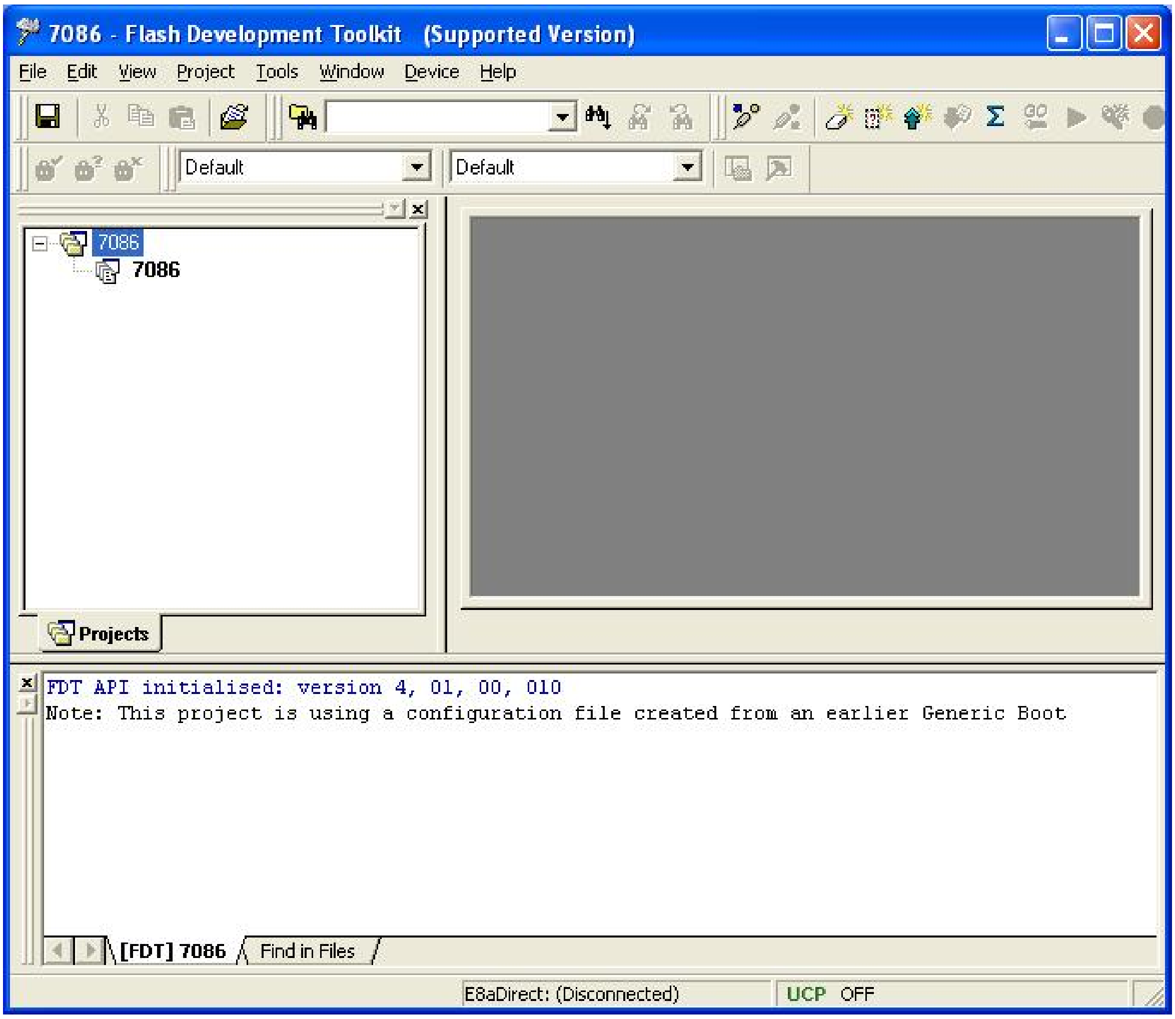
(1) Launch the Flash Development Toolkit.
From All Programs, choose “Flash Development Toolkit 4.01.”


FDT Help
FDT User Guide
Flash Development Toolkit 4.01
Flash Development Toolkit 4.01 Basic
Flash Development Toolkit 4.01
High-performance Embedded Workshop
License tool for E10A-USB Emulator
M16C-60,30,Tiny,20,10,R8C-Tiny Series C Compiler V.5.43 Rele...

(2) The Welcome! screen of the Flash Development Toolkit will be displayed.
Select the “Open Recently Used Project Workspace” radio button and then the project workspace file “7086.AWS,” and click OK.


Welcome!
Options:
○ Create a new project workspace
● Open a recent project workspace:
T4.01\Workspaces\7086\7086.AWS
○ Browse to another project workspace
OK
Cancel
Administration...

The 7086 project will be displayed.

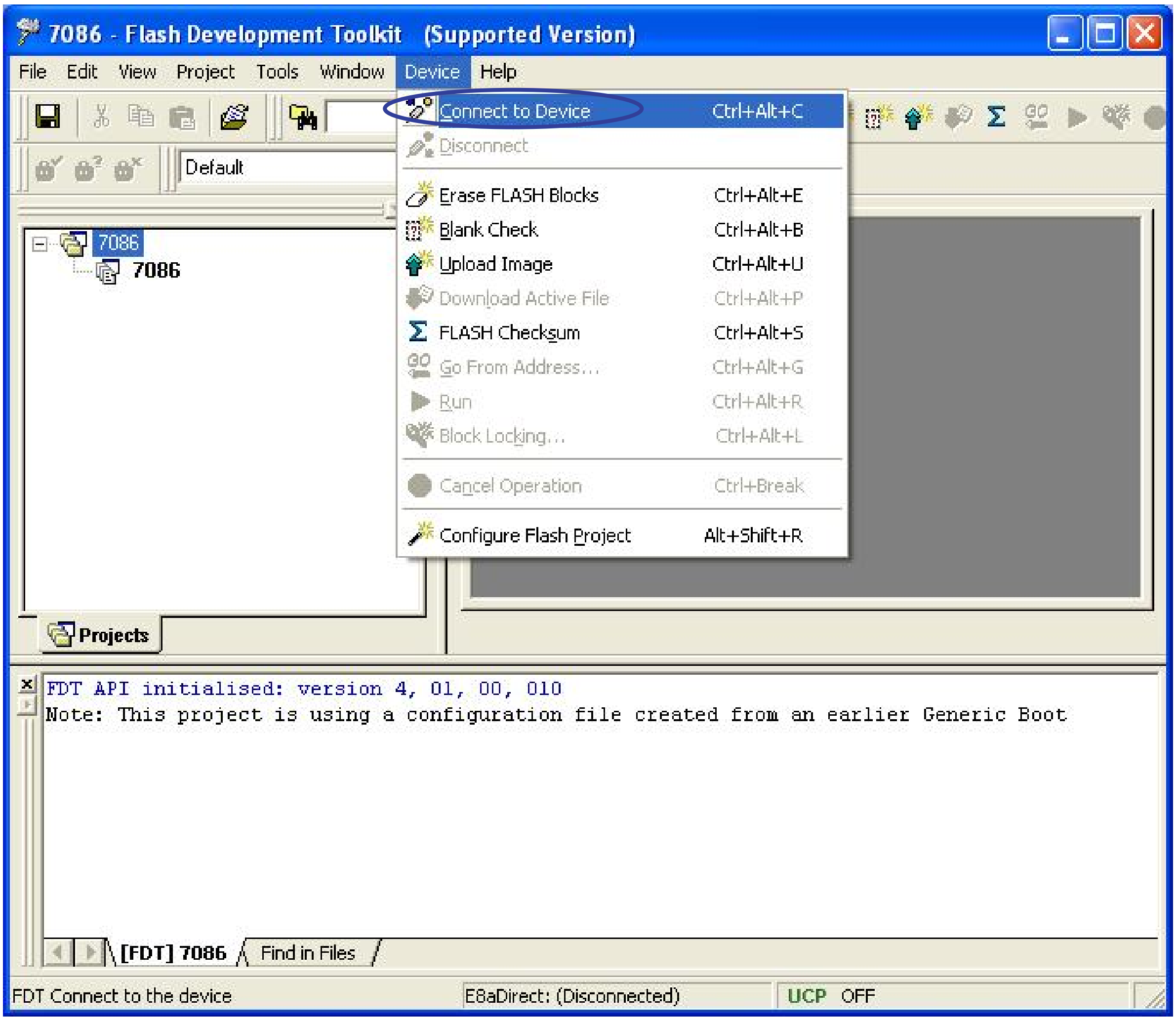


7086 - Flash Development Toolkit (Supported Version)
File Edit View Project Tools Window Device Help
Default
Default
7086
7086
Projects
[FDT] 7086
Find in Files
E8aDirect: (Disconnected)
UCP OFF

```
FDT API initialised: version 4, 01, 00, 010
Note: This project is using a configuration file created from an earlier Generic Boot
```

The Flash Development Toolkit can also be launched directly by opening the project workspace file “7086.AWS” (by double-clicking on it).

(3) Choose “Connect to Device” from the Device menu.

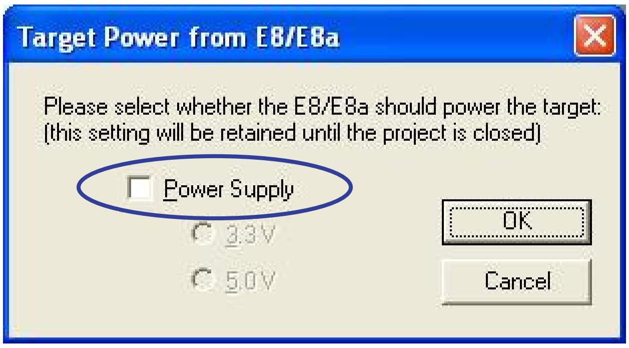


7086 - Flash Development Toolkit (Supported Version)
File Edit View Project Tools Window Device Help
Default
Connect to Device Ctrl+Alt+C
Disconnect
Erase FLASH Blocks Ctrl+Alt+E
Blank Check Ctrl+Alt+B
Upload Image Ctrl+Alt+U
Download Active File Ctrl+Alt+P
FLASH Checksum Ctrl+Alt+S
Go From Address... Ctrl+Alt+G
Run Ctrl+Alt+R
Block Locking... Ctrl+Alt+L
Cancel Operation Ctrl+Break
Configure Flash Project Alt+Shift+R
7086
7086
Projects
[FDT] 7086
Find in Files

```
FDT API initialised: version 4, 01, 00, 010
Note: This project is using a configuration file created from an earlier Generic Boot
```

FDT Connect to the device | E8aDirect: (Disconnected) | UCP OFF

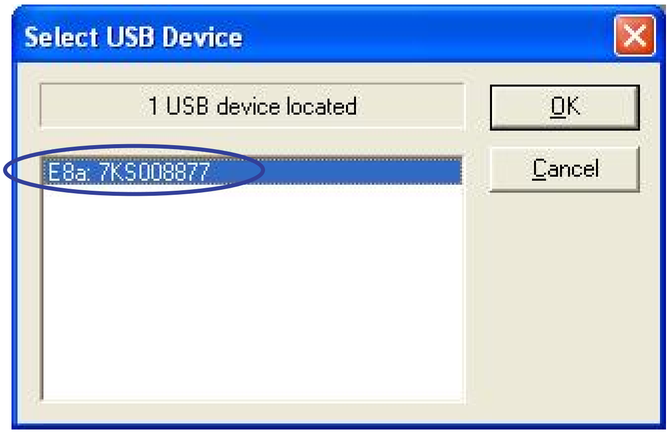
Simply click OK leaving the Power Supply check box unselected.



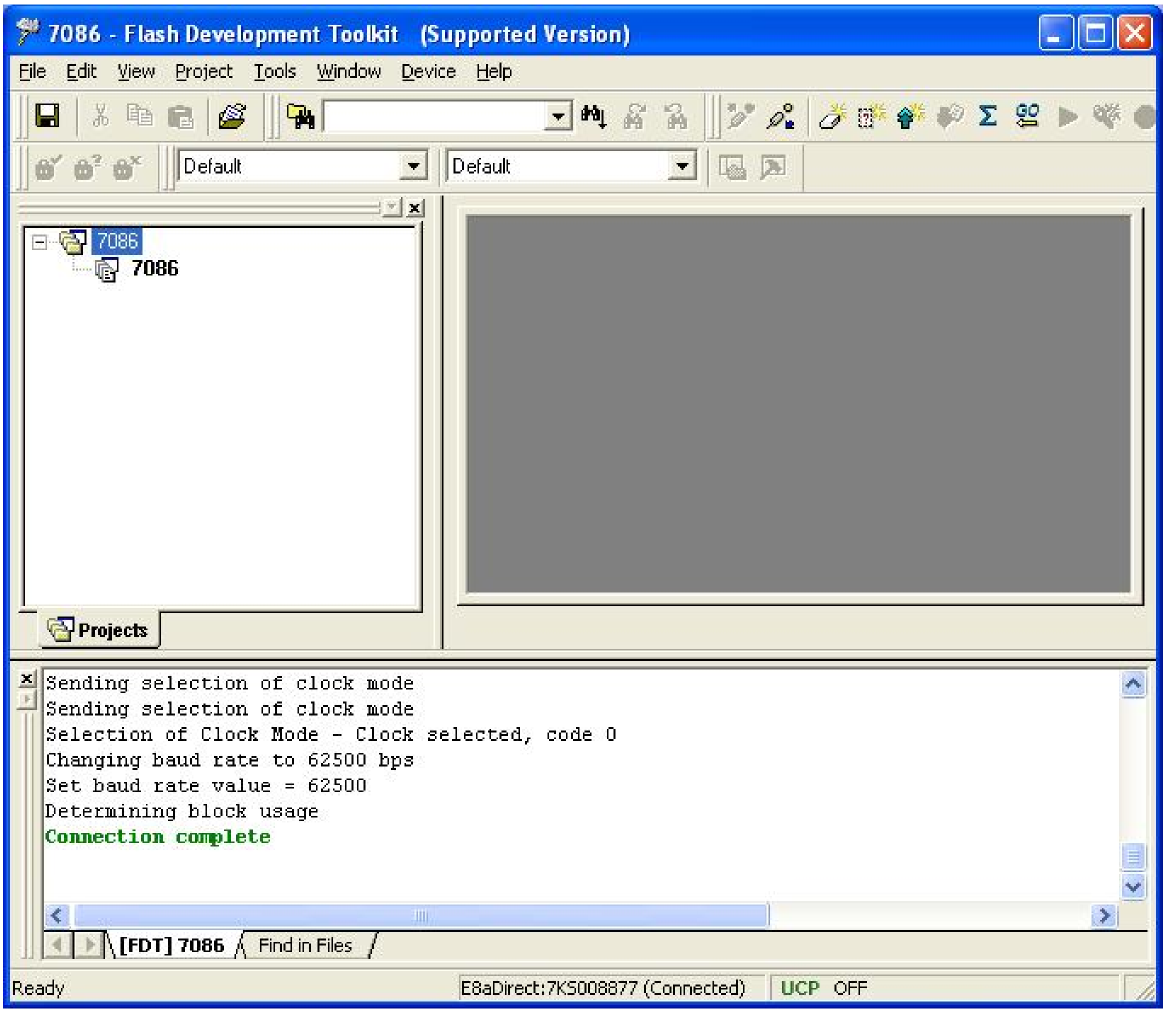
Please select whether the E8/E8a should power the target:
(this setting will be retained until the project is closed)

□ Power Supply
○ 3.3V
○ 5.0V

Select “E8a” and click OK.

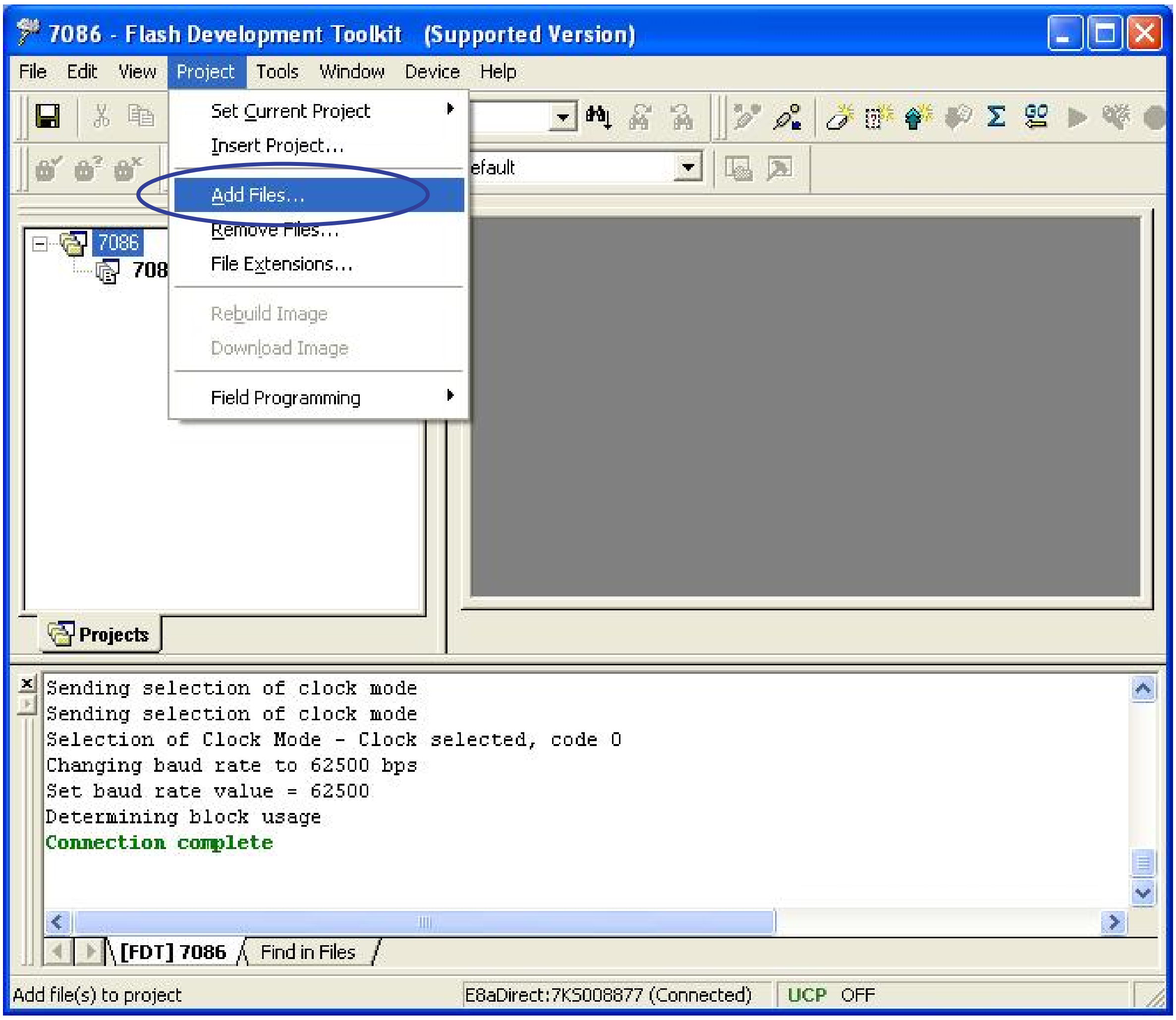


The device will be connected.


7086 - Flash Development Toolkit (Supported Version)
File Edit View Project Tools Window Device Help
Default
Default
7086
7086
Projects
[FDT] 7086
Find in Files
Ready
E8aDirect:7KS008877 (Connected)
UCP OFF

```
Sending selection of clock mode
Sending selection of clock mode
Selection of Clock Mode - Clock selected, code 0
Changing baud rate to 62500 bps
Set baud rate value = 62500
Determining block usage
Connection complete
```

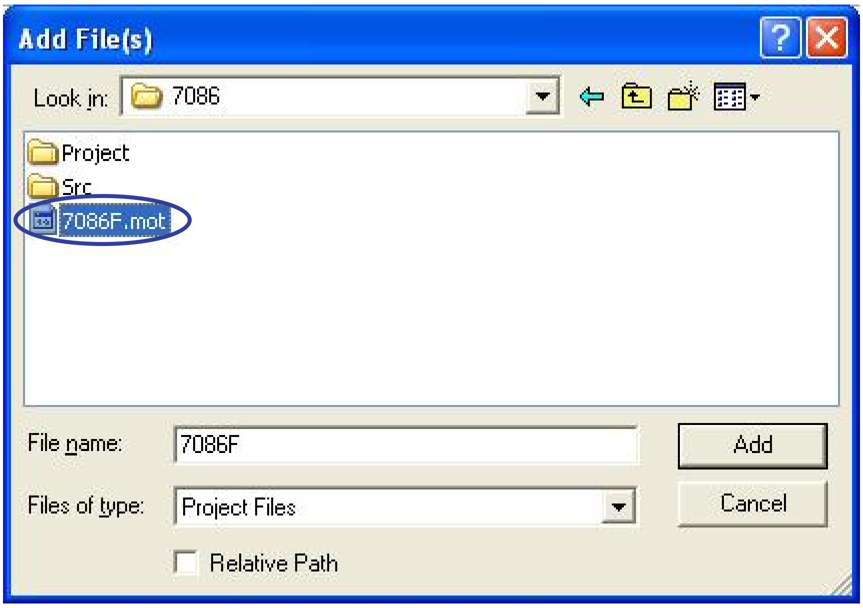
(4) Select the file to write.
Choose "Add File" from the Project menu.



```
Sending selection of clock mode
Sending selection of clock mode
Selection of Clock Mode - Clock selected, code 0
Changing baud rate to 62500 bps
Set baud rate value = 62500
Determining block usage
Connection complete
```

Add file(s) to project | E8aDirect:7KS008877 (Connected) | UCP OFF

(5) In the Add File dialog box, select the “7086F.mot” file and click Add.



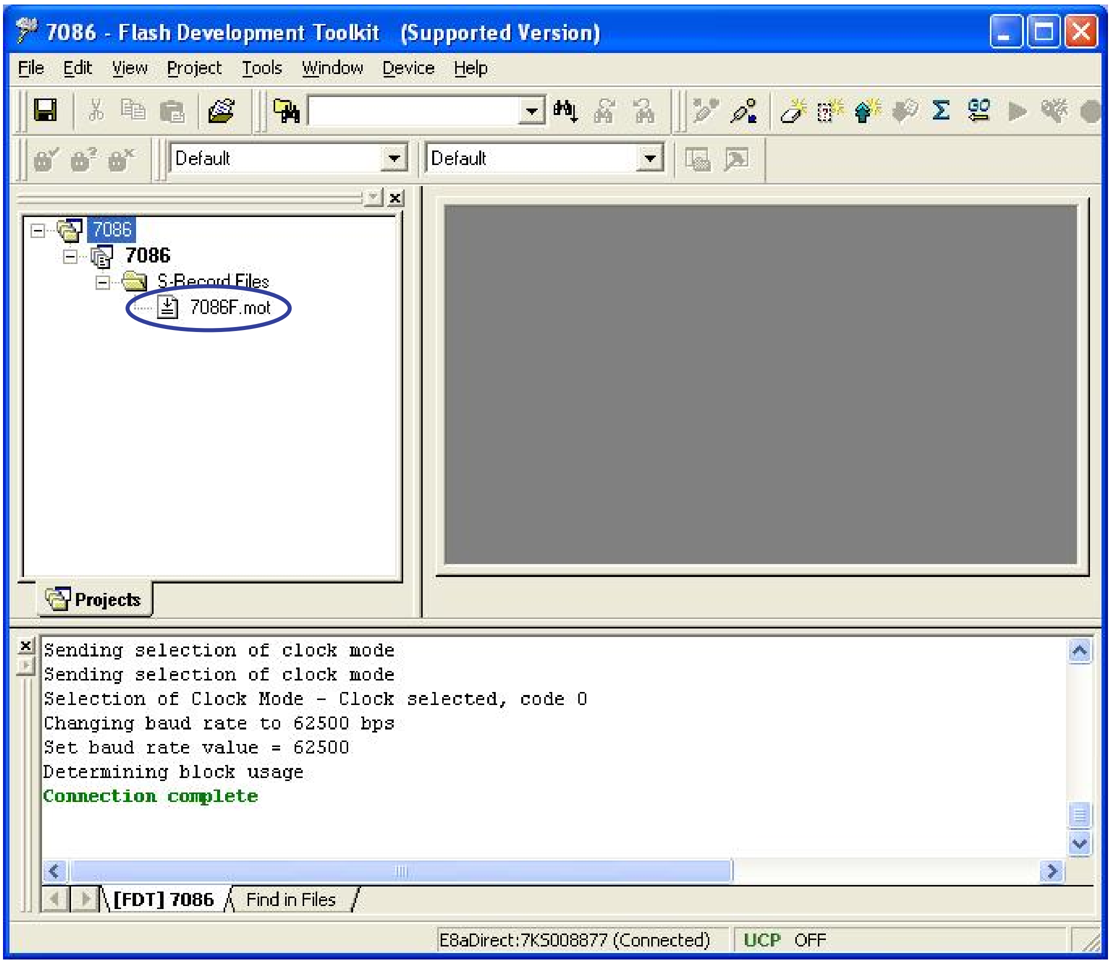
Look in: 7086

File name: 7086F

Files of type: Project Files

□ Relative Path

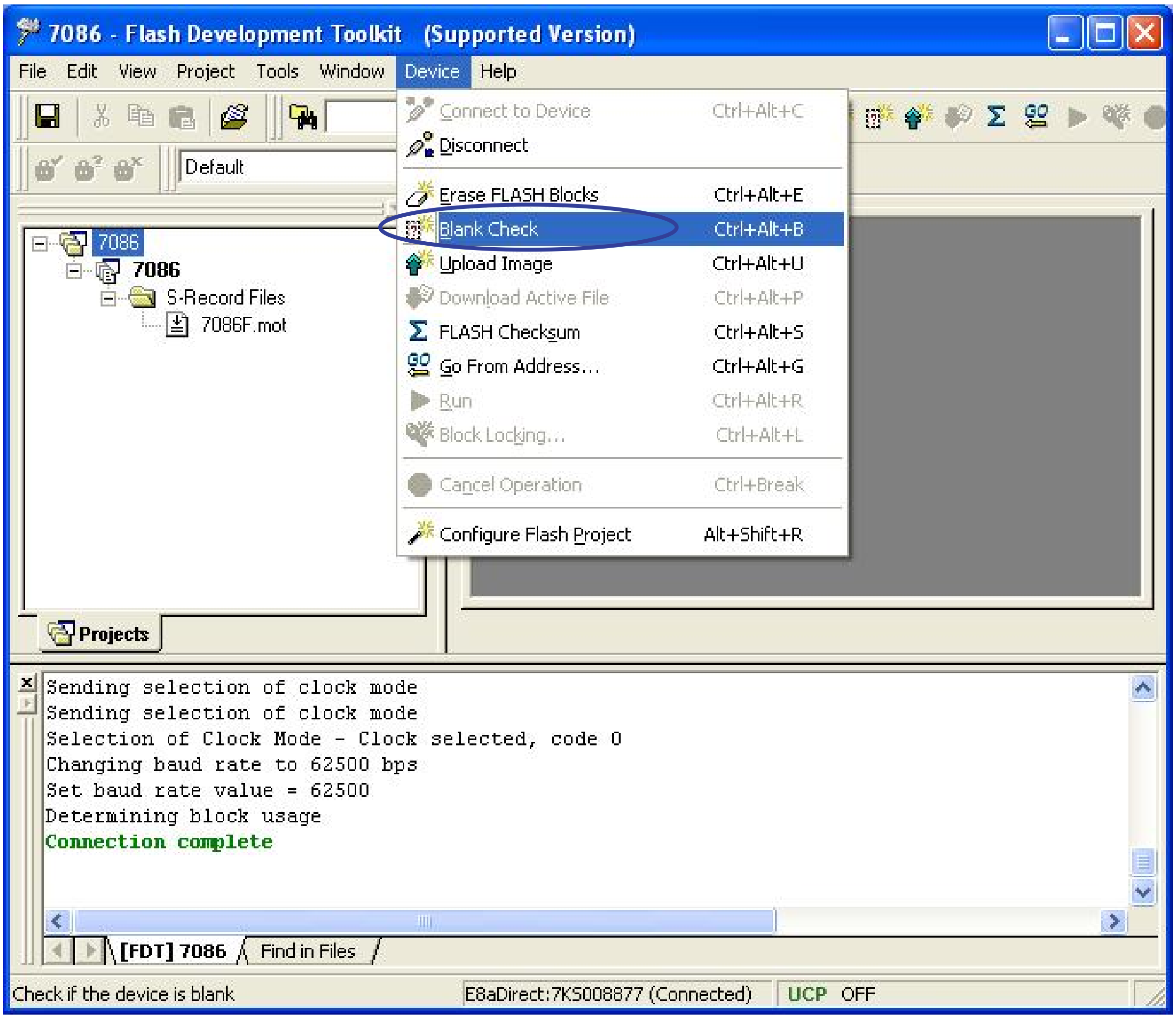
The “7086F.mot” file will be added to the project.


7086 - Flash Development Toolkit (Supported Version)
File Edit View Project Tools Window Device Help
Default
Default
7086
7086
S-Record Files
7086F.mot
Projects
[FDT] 7086
Find in Files

```
Sending selection of clock mode
Sending selection of clock mode
Selection of Clock Mode - Clock selected, code 0
Changing baud rate to 62500 bps
Set baud rate value = 62500
Determining block usage
Connection complete
```

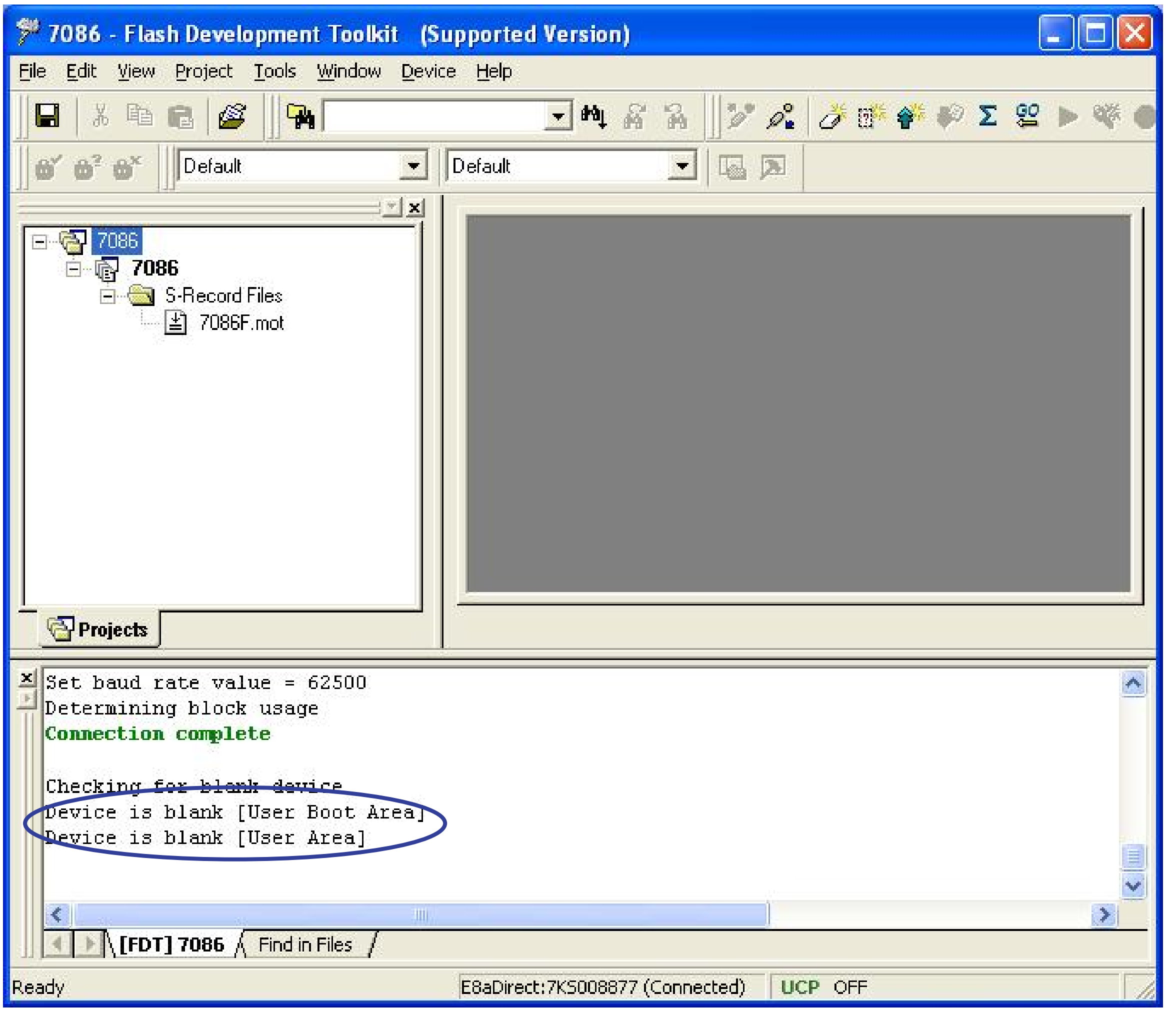
E8aDirect:7KS008877 (Connected) UCP OFF

(6) To verify that the user boot area and user area have no data written in each, perform a blank check. Choose “Blank Check” from the Device menu.


7086 - Flash Development Toolkit (Supported Version)
File Edit View Project Tools Window Device Help
Default
7086
7086
S-Record Files
7086F.mot
Projects
Connect to Device Ctrl+Alt+C
Disconnect
Erase FLASH Blocks Ctrl+Alt+E
Blank Check Ctrl+Alt+B
Upload Image Ctrl+Alt+U
Download Active File Ctrl+Alt+P
FLASH Checksum Ctrl+Alt+S
Go From Address... Ctrl+Alt+G
Run Ctrl+Alt+R
Block Locking... Ctrl+Alt+L
Cancel Operation Ctrl+Break
Configure Flash Project Alt+Shift+R
[FDT] 7086
Find in Files
Check if the device is blank
E8aDirect:7KS008877 (Connected)
UCP OFF

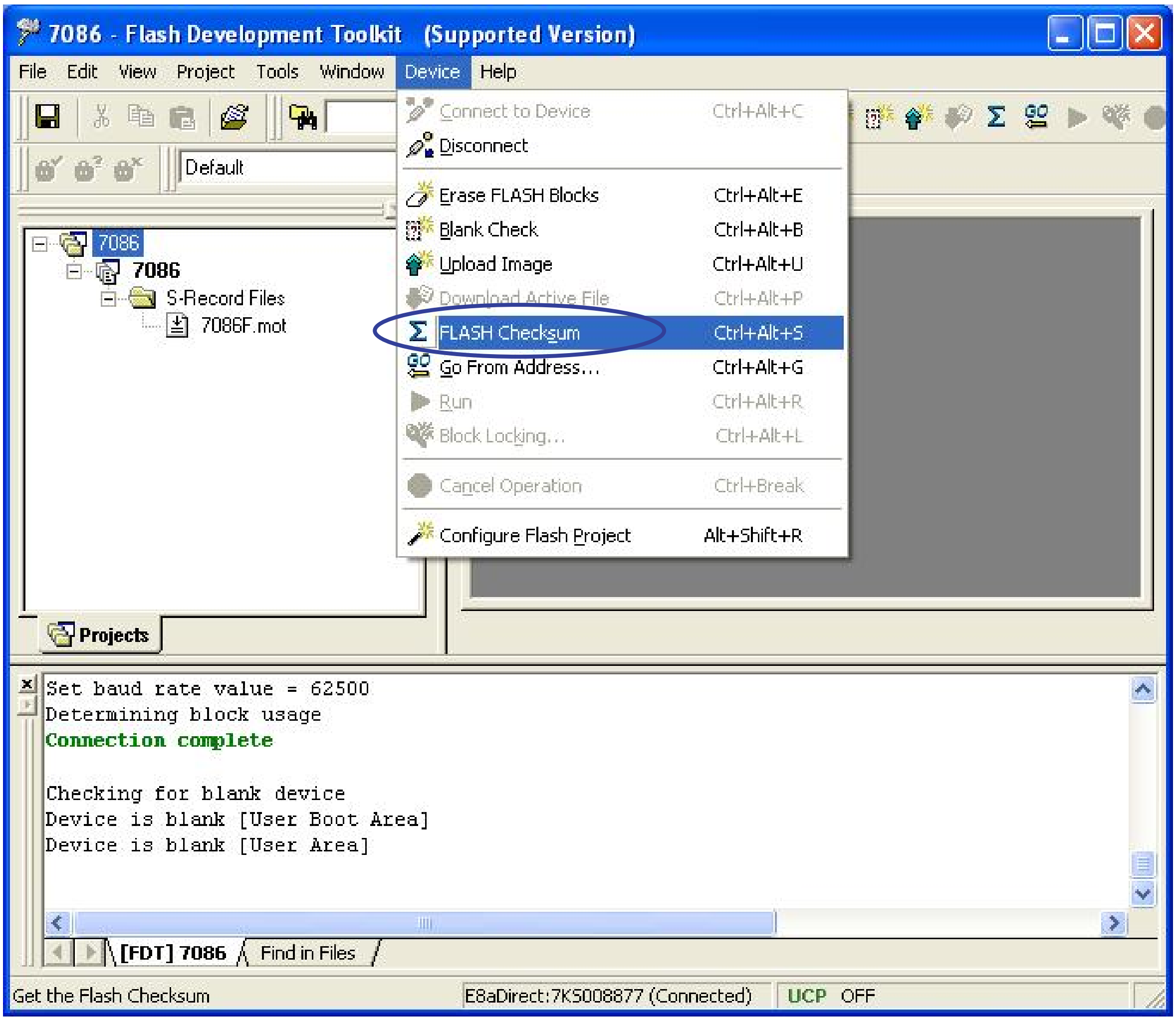
```
Sending selection of clock mode
Sending selection of clock mode
Selection of Clock Mode - Clock selected, code 0
Changing baud rate to 62500 bps
Set baud rate value = 62500
Determining block usage
Connection complete
```

The result of a blank check will be displayed. It shows that the user boot area and user area have no data written in each.


7086 - Flash Development Toolkit (Supported Version)
File Edit View Project Tools Window Device Help
Default
Default
7086
7086
S-Record Files
7086F.mot
Projects
[FDT] 7086
Find in Files
Ready
E8aDirect:7KS008877 (Connected)
UCP OFF

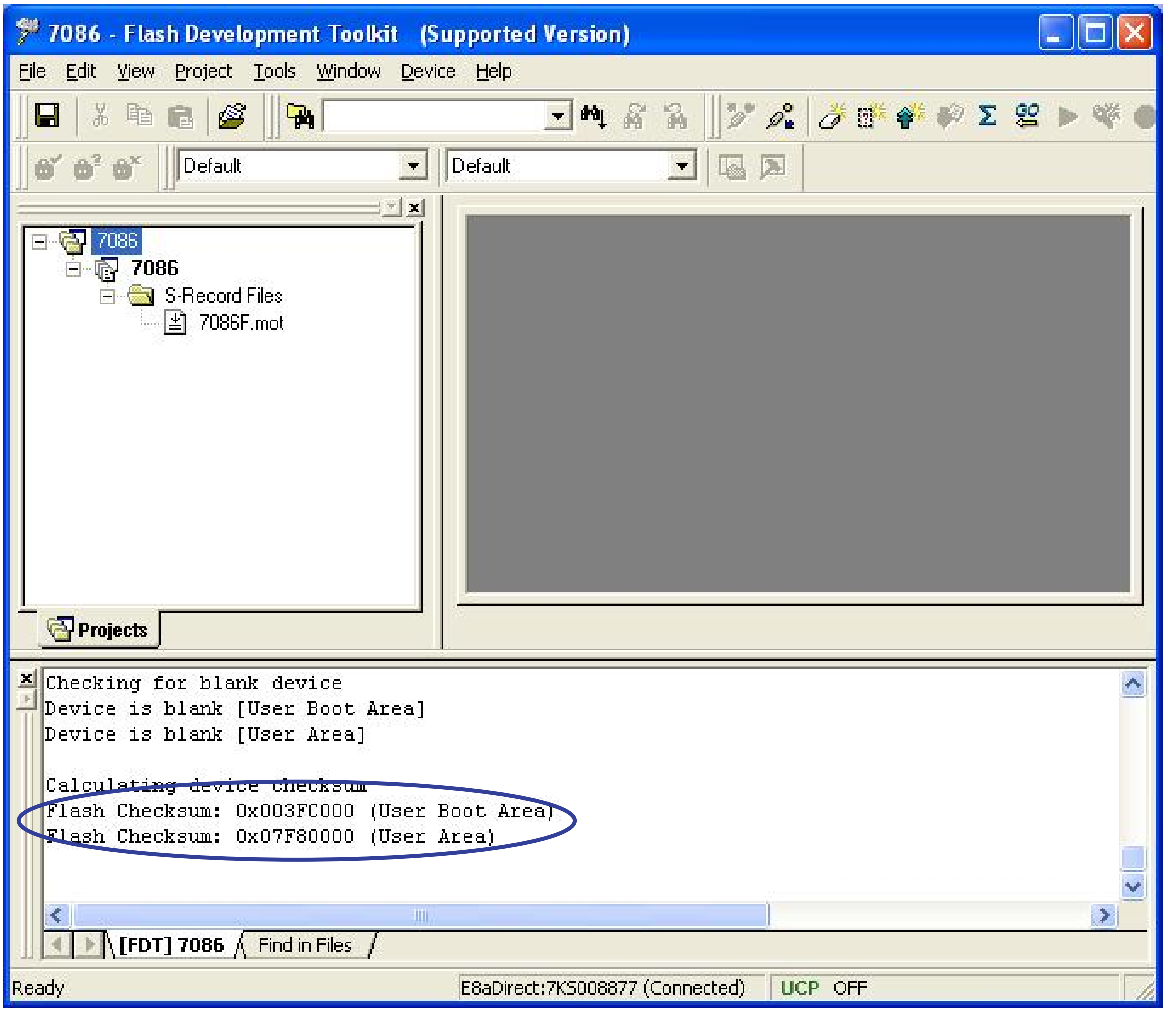
```
Set baud rate value = 62500
Determining block usage
Connection complete

Checking for blank device
Device is blank [User Boot Area]
Device is blank [User Area]
```

(7) Verify a checksum value of the user boot area and user area when these areas have no data written in each.
Choose “Flash Checksum” from the Device menu.


7086 - Flash Development Toolkit (Supported Version)
File Edit View Project Tools Window Device Help
Default
7086
7086
S-Record Files
7086F.mot
Projects
Connect to Device Ctrl+Alt+C
Disconnect
Erase FLASH Blocks Ctrl+Alt+E
Blank Check Ctrl+Alt+B
Upload Image Ctrl+Alt+U
Download Active File Ctrl+Alt+P
FLASH Checksum Ctrl+Alt+S
Go From Address... Ctrl+Alt+G
Run Ctrl+Alt+R
Block Locking... Ctrl+Alt+L
Cancel Operation Ctrl+Break
Configure Flash Project Alt+Shift+R
[FDT] 7086
Find in Files
Get the Flash Checksum
E8aDirect:7KS008877 (Connected)
UCP OFF

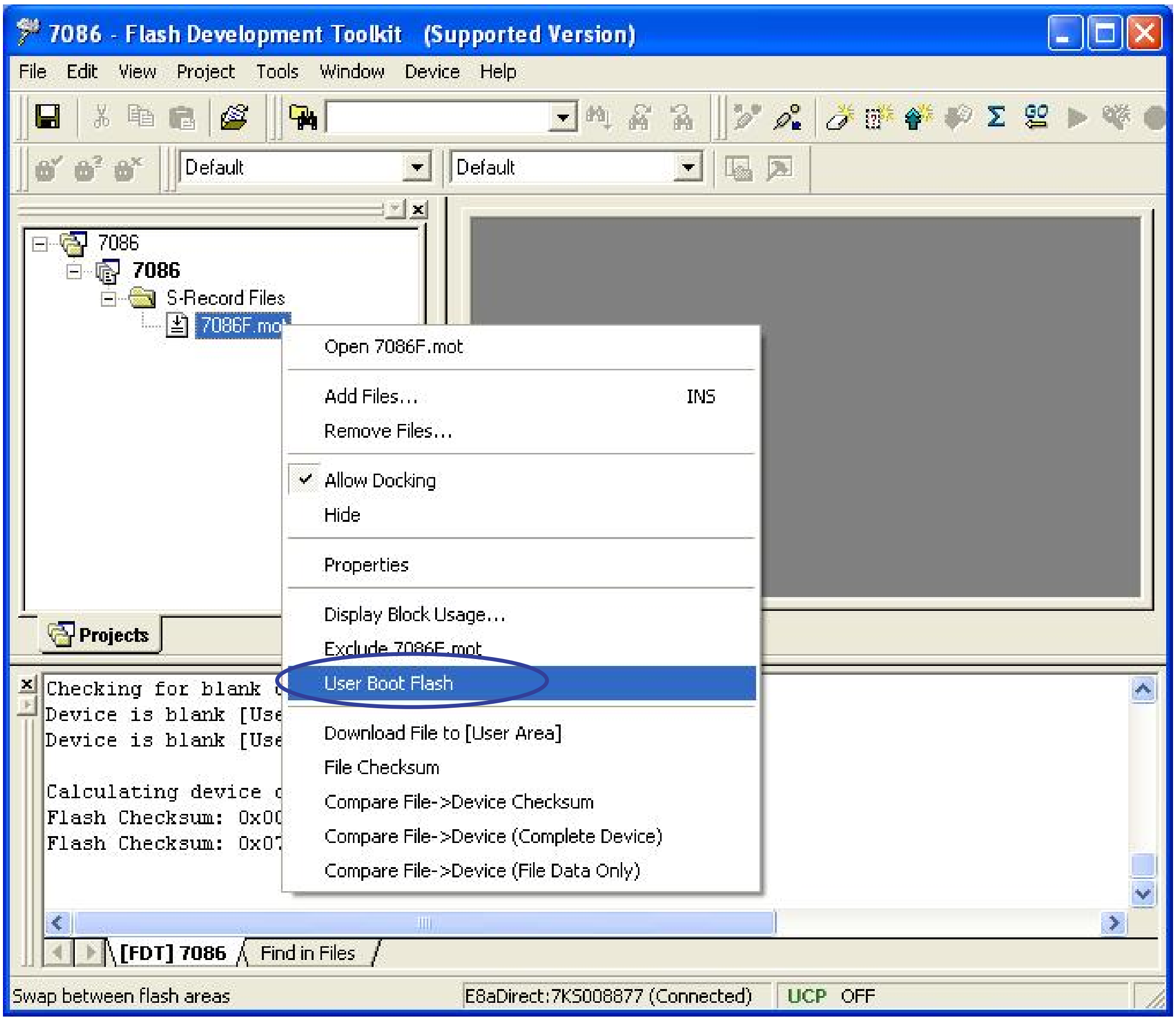
```
Set baud rate value = 62500
Determining block usage
Connection complete

Checking for blank device
Device is blank [User Boot Area]
Device is blank [User Area]
```

The result of a checksum will be displayed.


7086 - Flash Development Toolkit (Supported Version)
File Edit View Project Tools Window Device Help
Default
Default
7086
7086
S-Record Files
7086F.mot
Projects
[FDT] 7086
Find in Files
Ready
E8aDirect:7KS008877 (Connected)
UCP OFF

```
Checking for blank device
Device is blank [User Boot Area]
Device is blank [User Area]

Calculating device checksum
Flash Checksum: 0x003FC000 (User Boot Area)
Flash Checksum: 0x07F80000 (User Area)
```

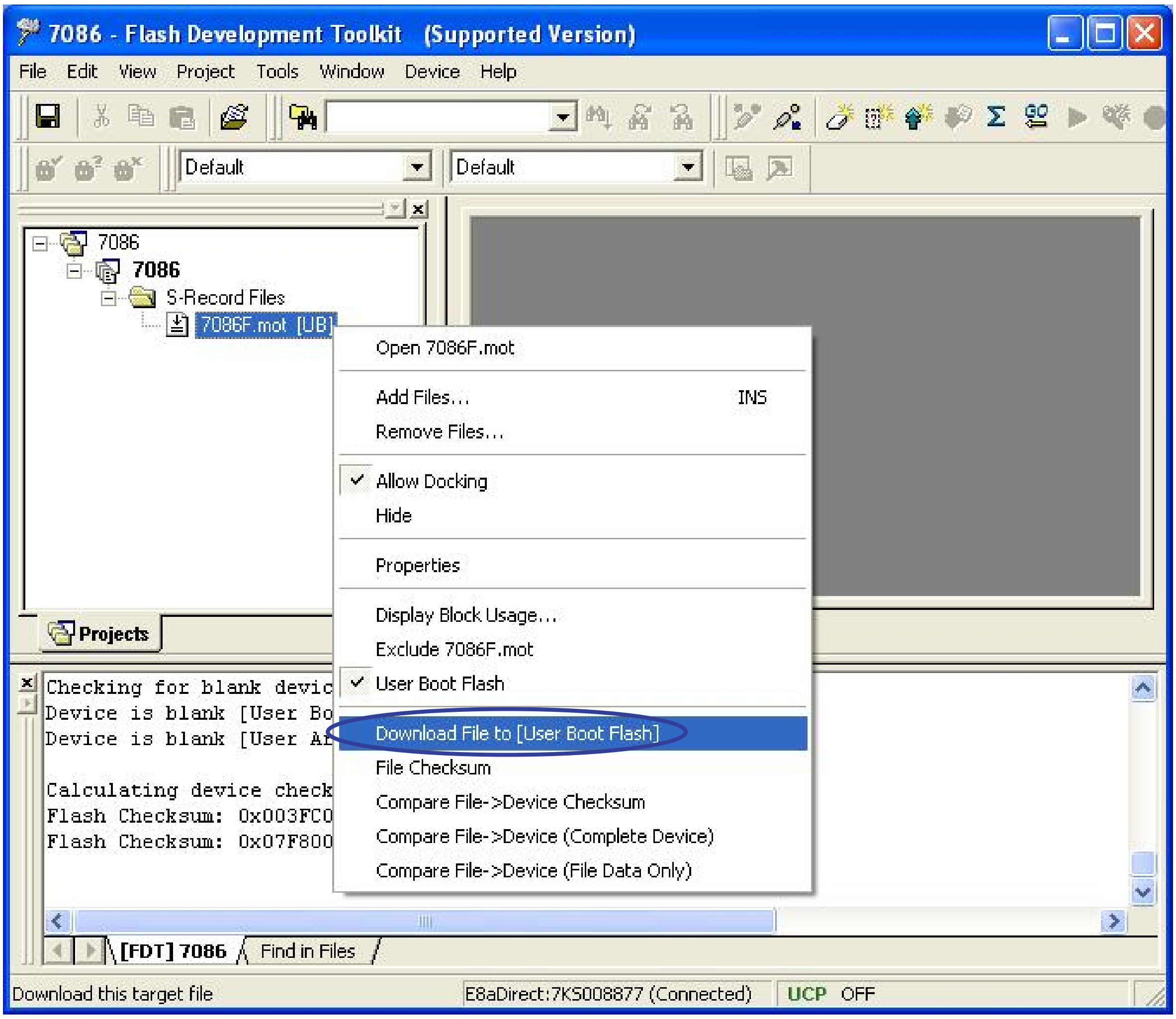
(8) Set the user boot area as a preparatory step before writing to that area.
Right-click the 7086F.mot file, and from the popup menu choose “User Boot Flash” to set the user boot area for the download destination.



```
Checking for blank (
Device is blank [Use
Device is blank [Use

Calculating device c
Flash Checksum: 0x00
Flash Checksum: 0x07
```

Swap between flash areas
E8aDirect:7KS008877 (Connected)
UCP OFF

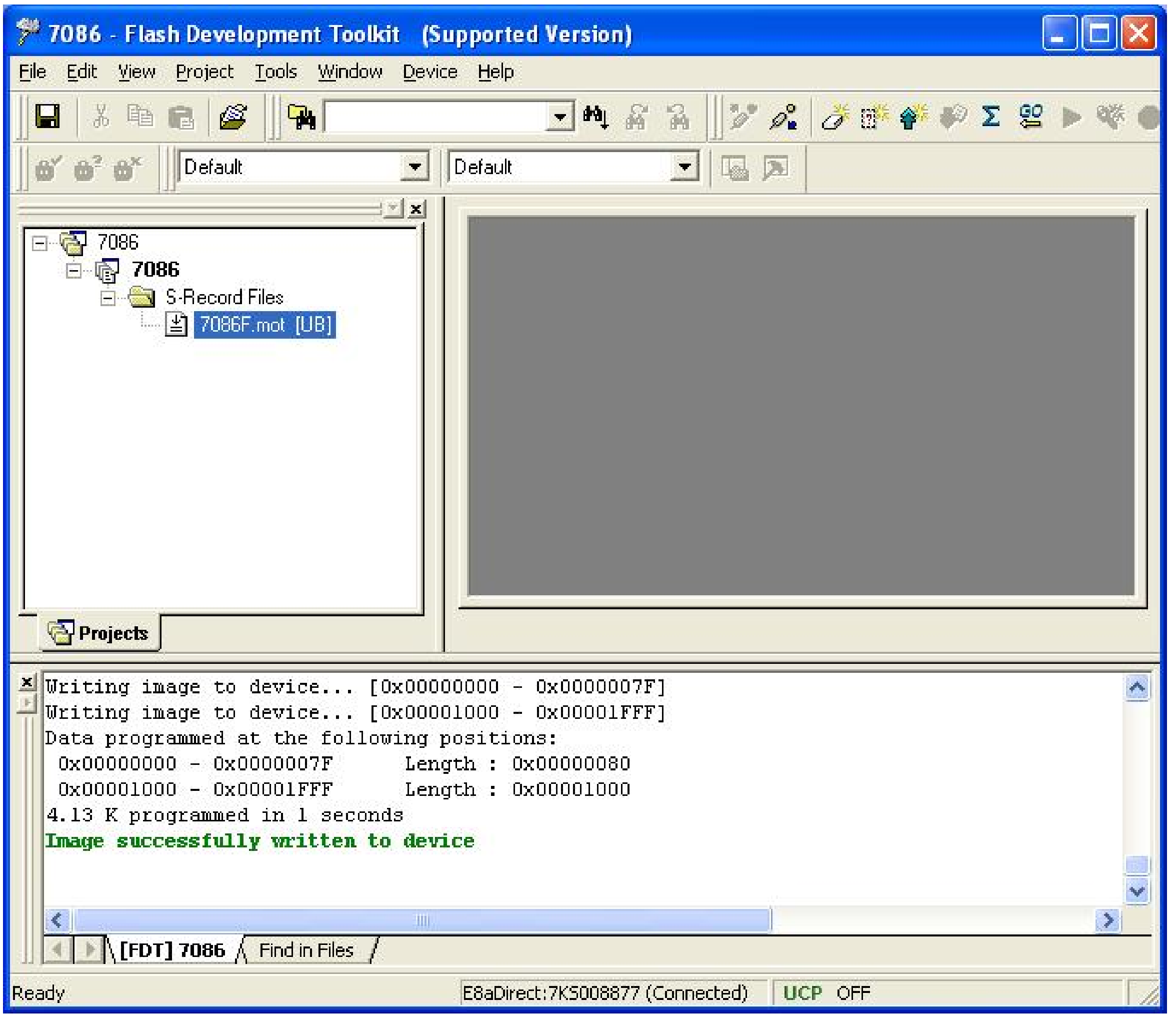
(9) Right-click the 7086F.mot file again, and from the popup menu choose “Download [User Boot Flash]” to download the 7086F.mot file into the user boot area.



```
Checking for blank devic
Device is blank [User Bo
Device is blank [User Ap

Calculating device check
Flash Checksum: 0x003FC0
Flash Checksum: 0x07F800
```

Download this target file | E8aDirect:7KS008877 (Connected) | UCP OFF

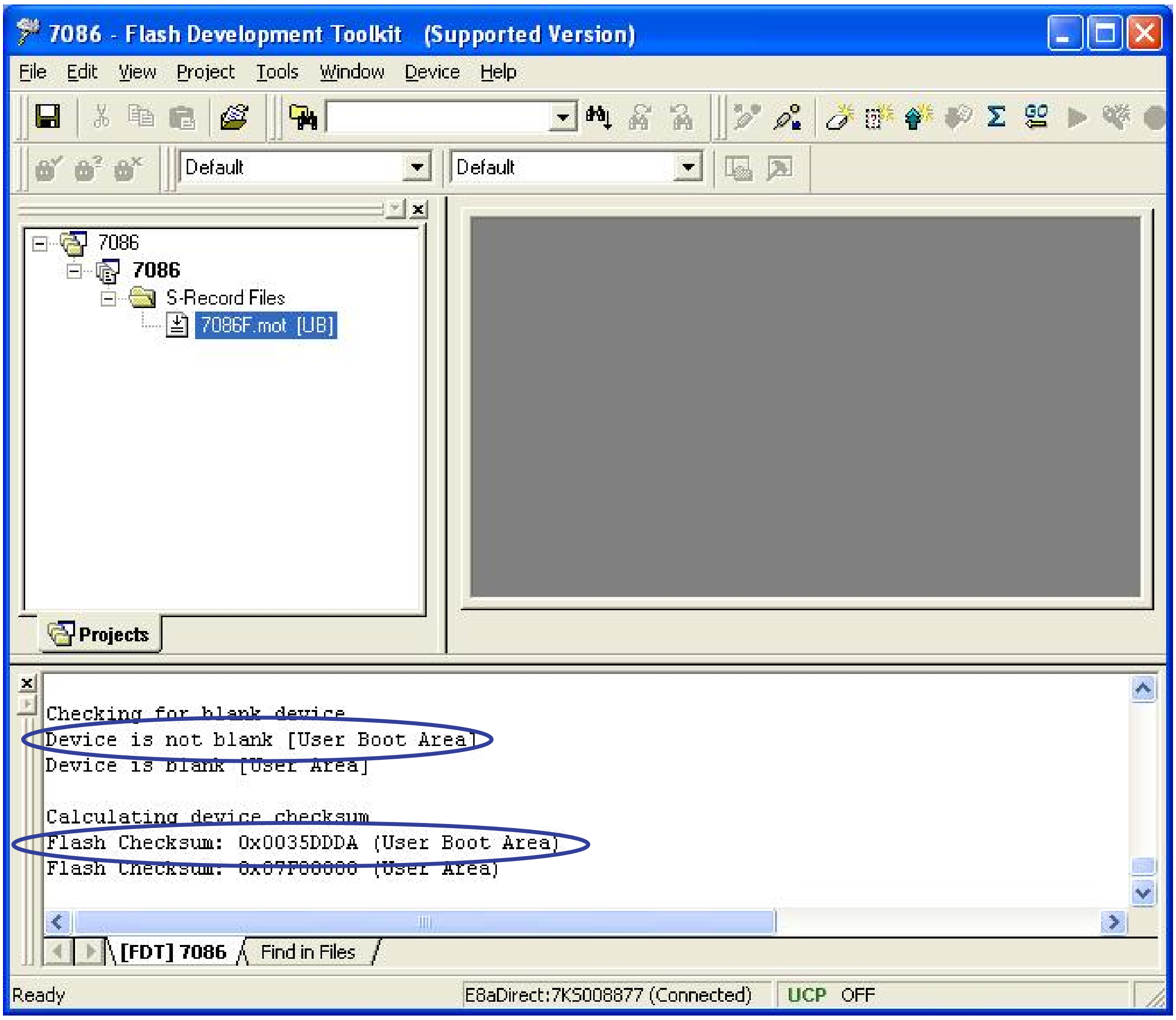
The program has been downloaded into the user boot area.



7086 - Flash Development Toolkit (Supported Version)
File Edit View Project Tools Window Device Help
Default
Default
7086
7086
S-Record Files
7086F.mot [UB]
Projects
[FDT] 7086
Find in Files
Ready
E8aDirect:7KS008877 (Connected)
UCP OFF

```
Writing image to device... [0x00000000 - 0x0000007F]
Writing image to device... [0x00001000 - 0x00001FFF]
Data programmed at the following positions:
 0x00000000 - 0x0000007F      Length : 0x00000080
 0x00001000 - 0x00001FFF      Length : 0x00001000
4.13 K programmed in 1 seconds
Image successfully written to device
```

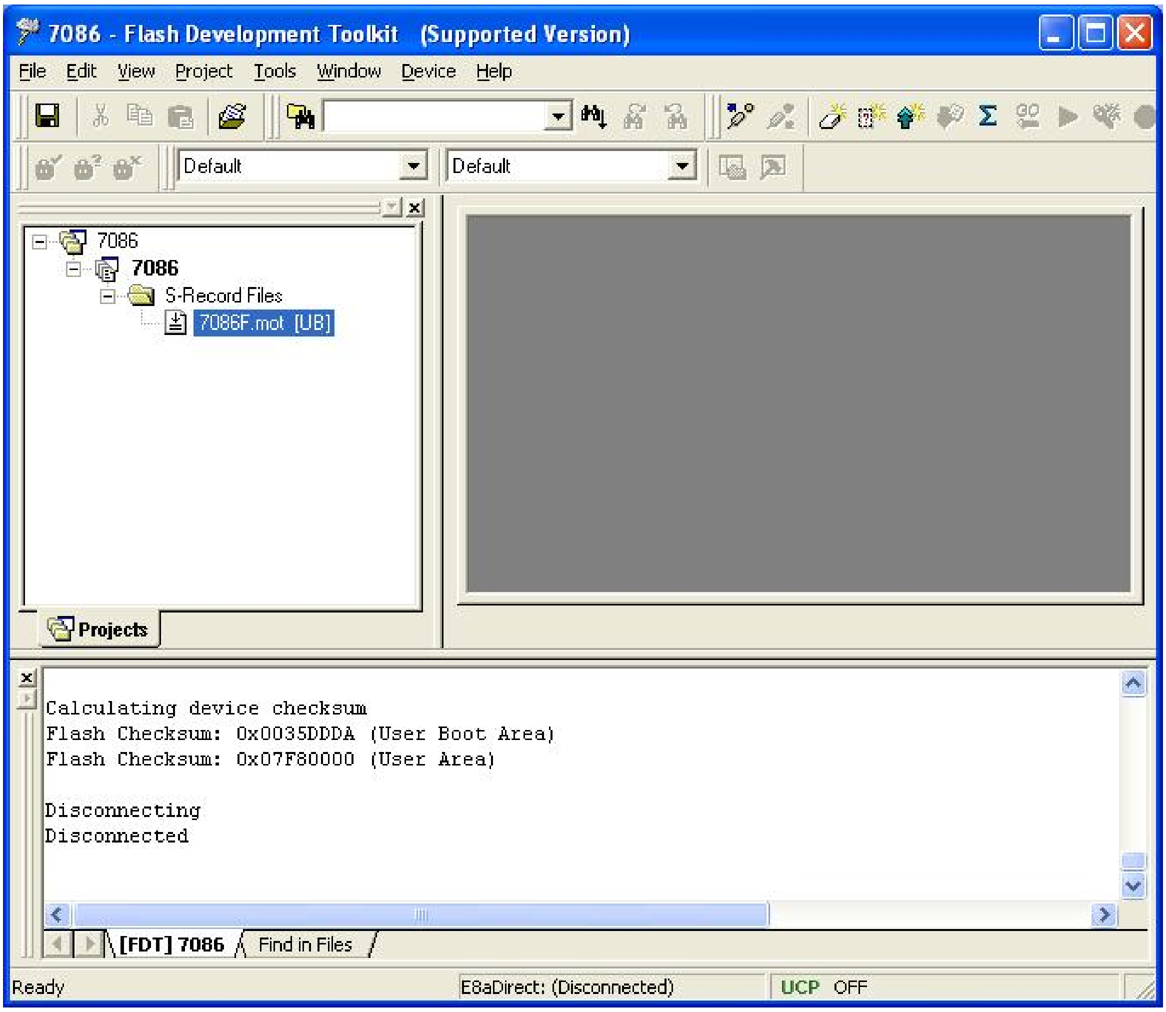
(10) To verify that the program has been written to the user boot area, perform a blank check and a checksum.
Choose “Blank Check” from the Device menu.
Choose “Flash Checksum” from the Device menu.
The results of a blank check and a checksum will be displayed.


7086 - Flash Development Toolkit (Supported Version)
File Edit View Project Tools Window Device Help
Default
Default
7086
7086
S-Record Files
7086F.mot [UB]
Projects
[FDT] 7086
Find in Files
Ready
E8aDirect:7KS008877 (Connected)
UCP OFF

```
Checking for blank device
Device is not blank [User Boot Area]
Device is blank [User Area]

Calculating device checksum
Flash Checksum: 0x0035DDDA (User Boot Area)
Flash Checksum: 0x07F80000 (User Area)
```

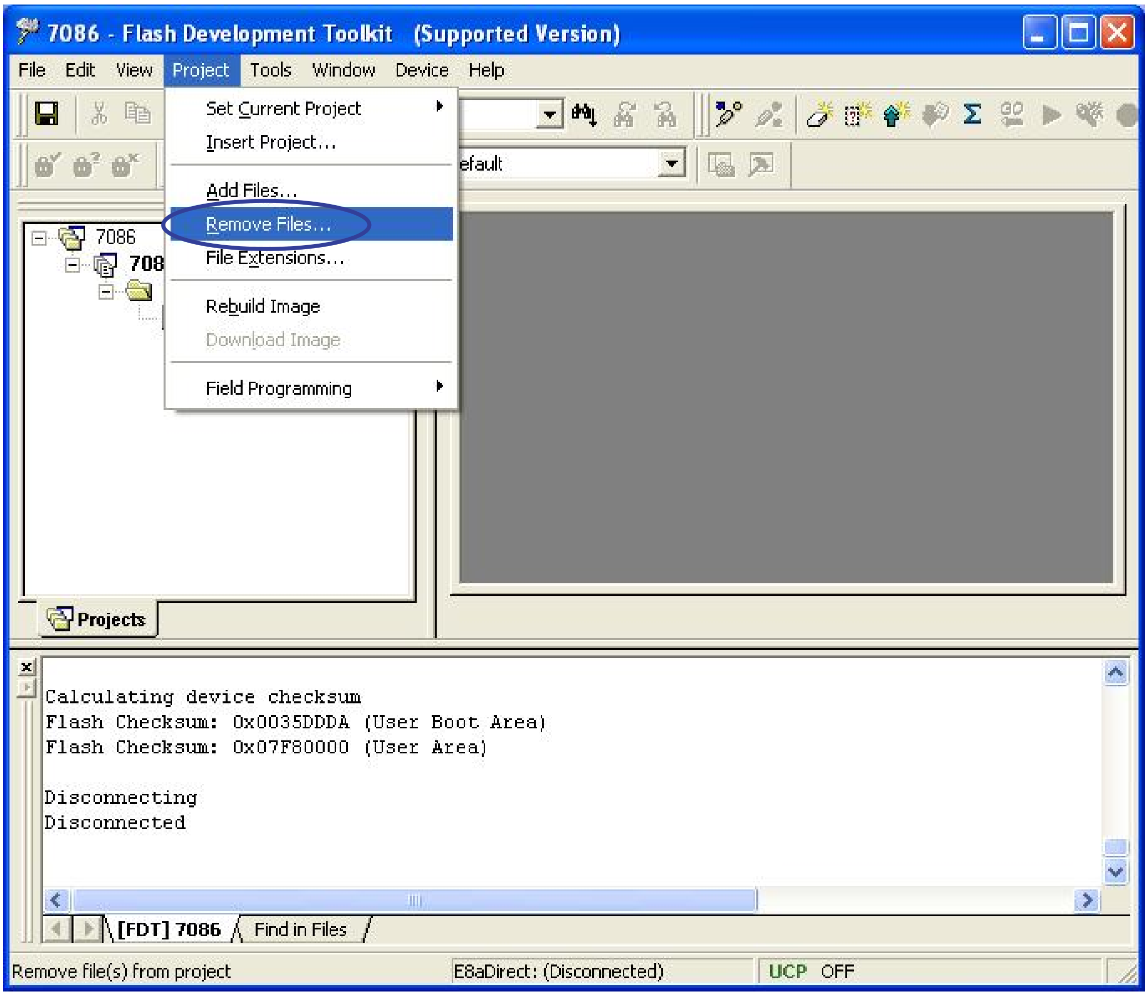
The result shows that the program has been written to the user boot area.

(11) Choose “Disconnect from Device” from the Device menu to disconnect the device.


7086 - Flash Development Toolkit (Supported Version)
File Edit View Project Tools Window Device Help
Default
Default
7086
7086
S-Record Files
7086F.mot [UB]
Projects
[FDT] 7086
Find in Files
Ready
E8aDirect: (Disconnected)
UCP OFF

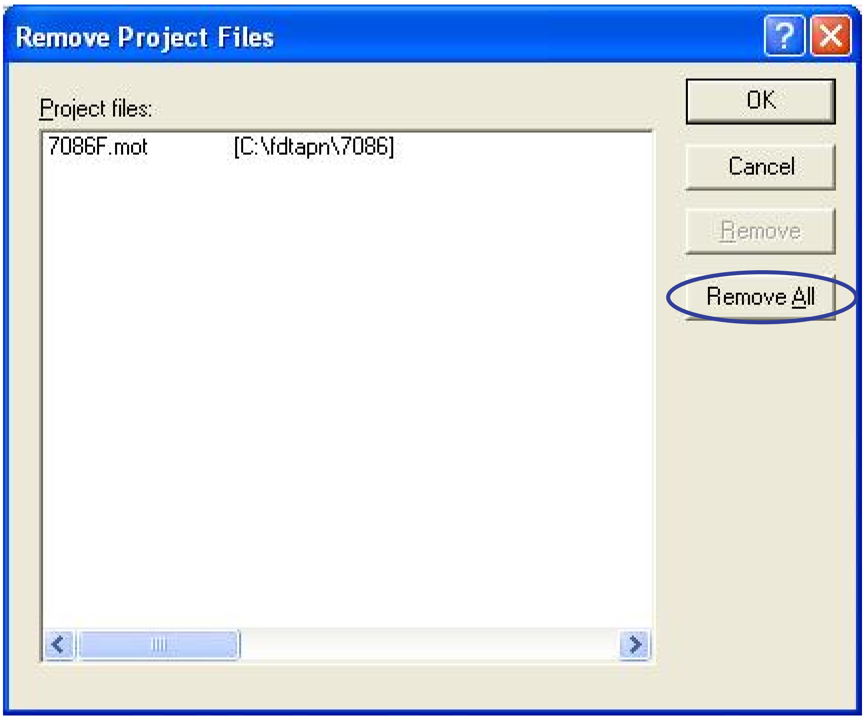
```
Calculating device checksum
Flash Checksum: 0x0035DDDA (User Boot Area)
Flash Checksum: 0x07F80000 (User Area)

Disconnecting
Disconnected
```

(12) Delete a file.
Choose “Delete Files” from the Project menu.



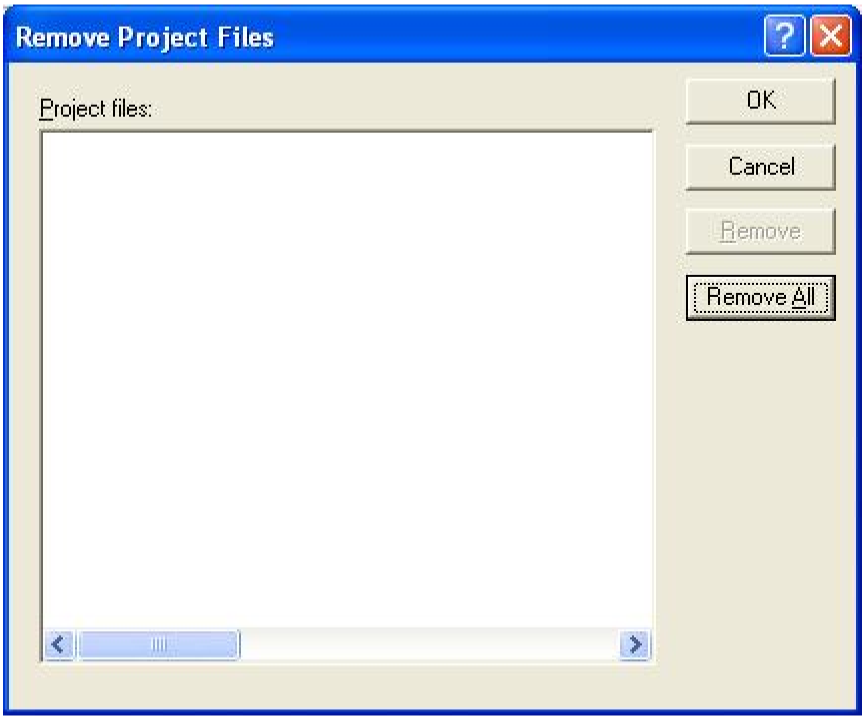
```
Calculating device checksum
Flash Checksum: 0x0035DDDA (User Boot Area)
Flash Checksum: 0x07F80000 (User Area)

Disconnecting
Disconnected
```

(13) The Delete Project Files dialog box will be displayed. Click the Delete All button.

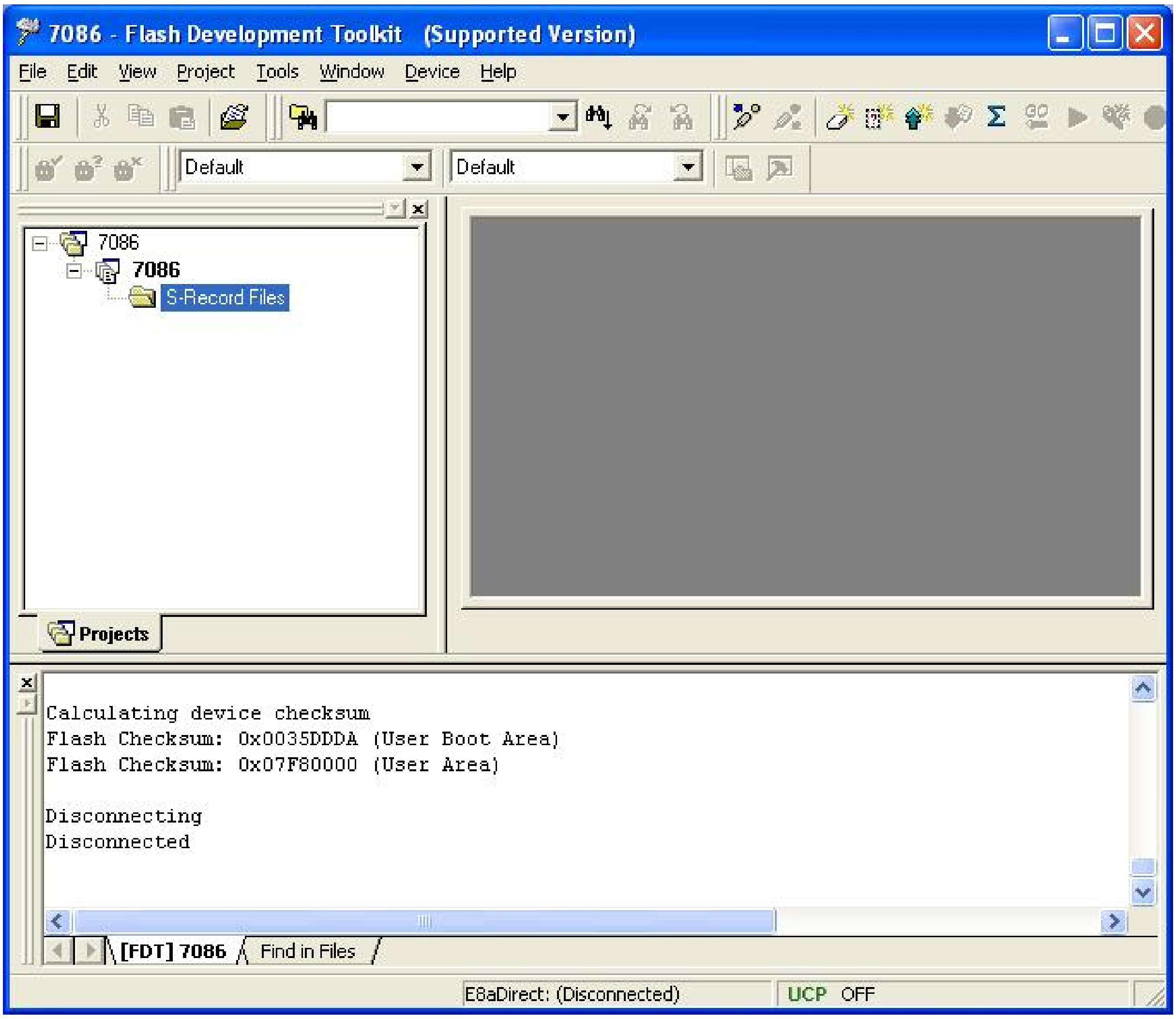


7086F.mot [C:\fdtapn\7086]

Click OK.

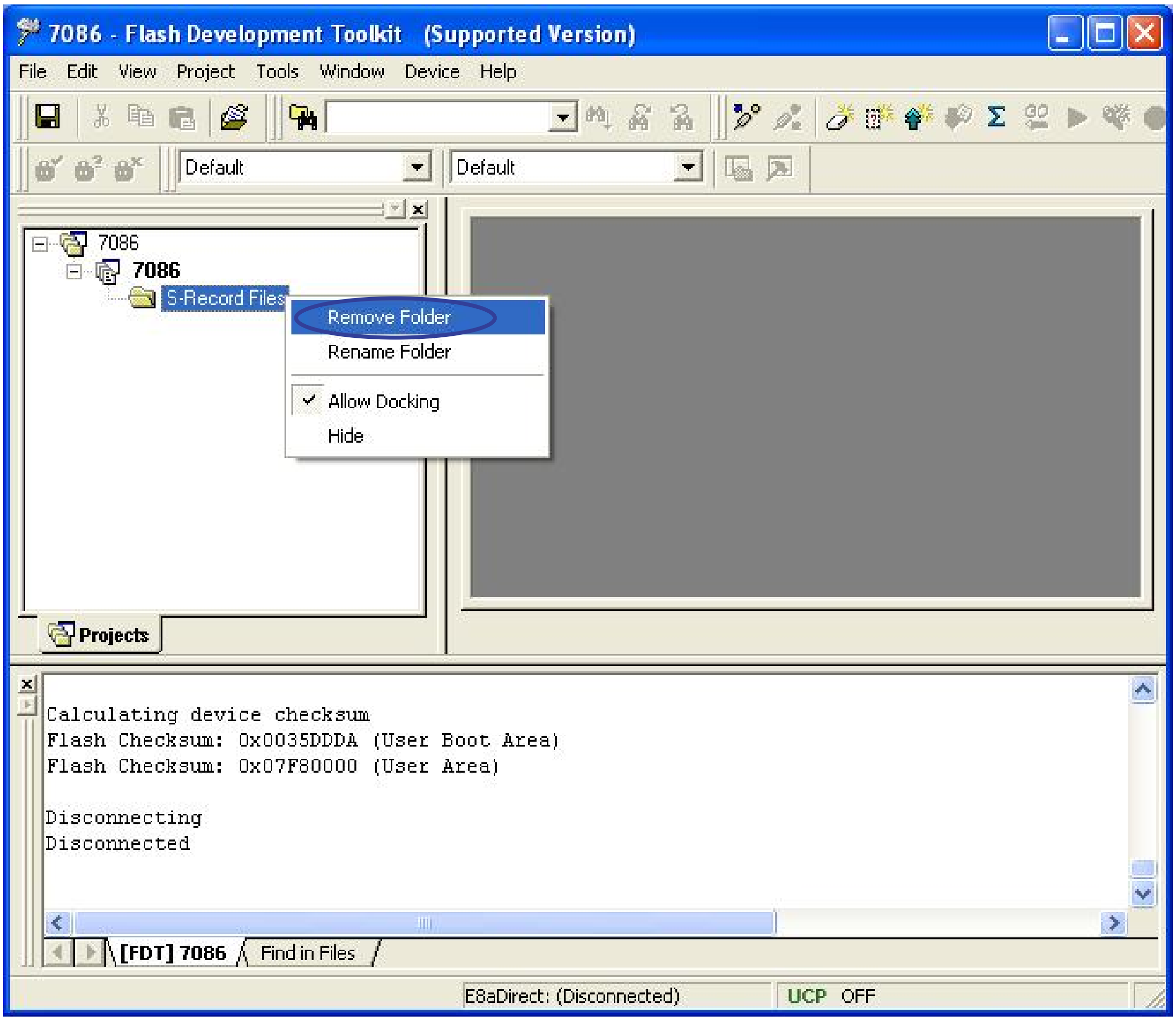


The files will be deleted.


7086 - Flash Development Toolkit (Supported Version)
File Edit View Project Tools Window Device Help
Default
Default
7086
7086
S-Record Files
Projects
[FDT] 7086
Find in Files
E8aDirect: (Disconnected)
UCP OFF

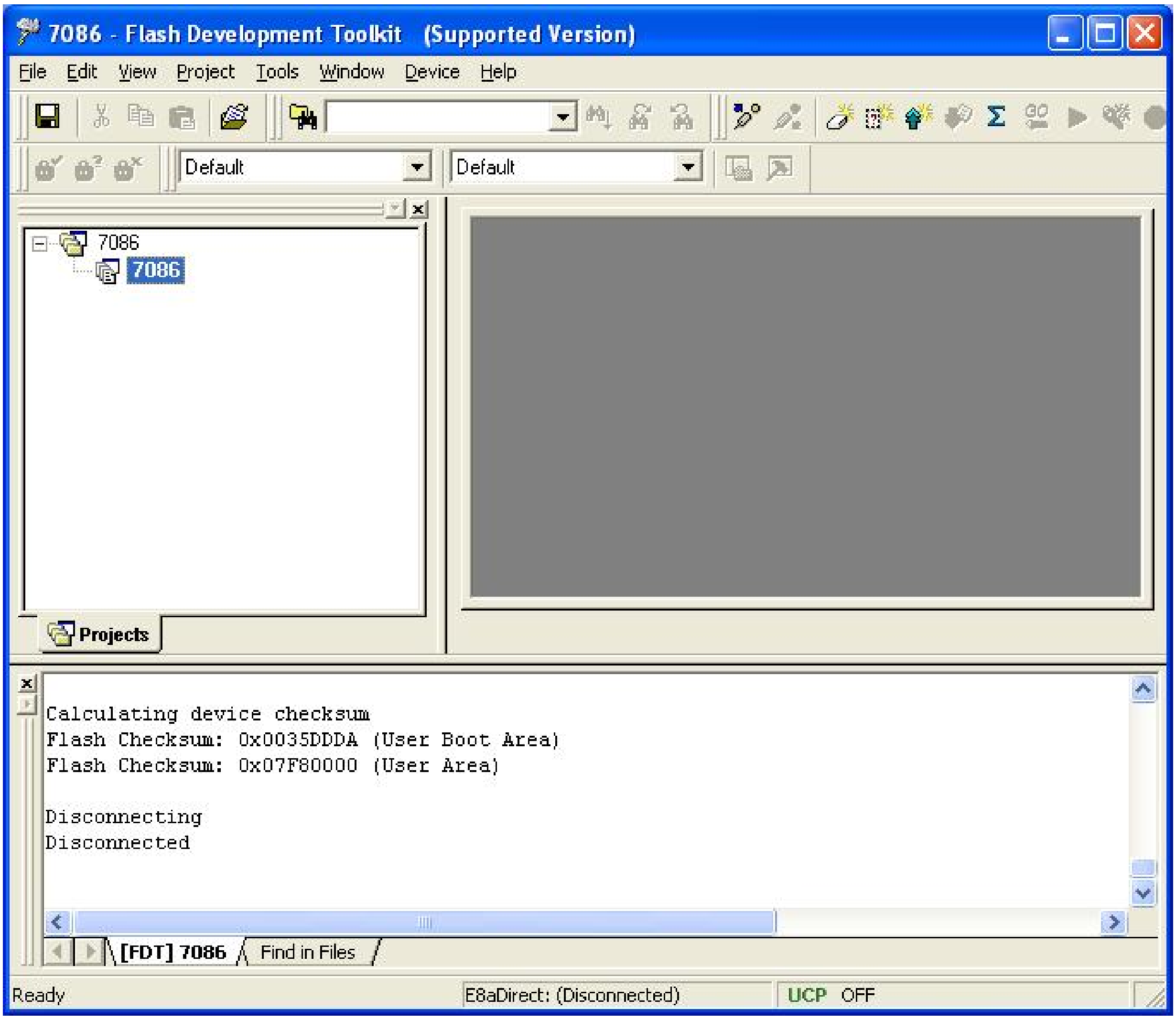
```
Calculating device checksum
Flash Checksum: 0x0035DDDA (User Boot Area)
Flash Checksum: 0x07F80000 (User Area)

Disconnecting
Disconnected
```

(14) Delete a folder.
Right-click a folder, and from the popup menu choose “Delete Folder.”



```
Calculating device checksum
Flash Checksum: 0x0035DDDA (User Boot Area)
Flash Checksum: 0x07F80000 (User Area)

Disconnecting
Disconnected
```

The folder will be deleted.

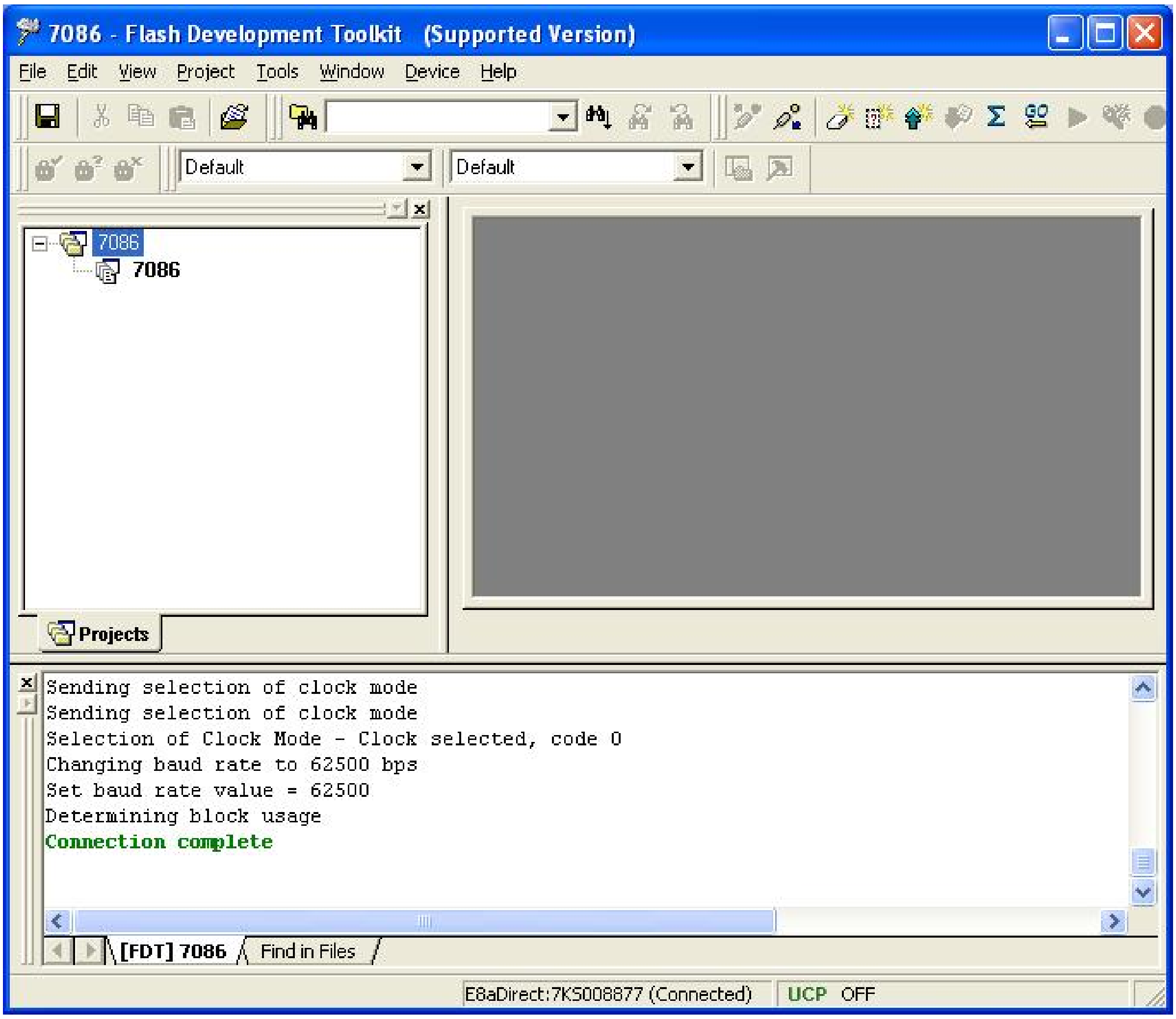

7086 - Flash Development Toolkit (Supported Version)
File Edit View Project Tools Window Device Help
Default
Default
7086
7086
Projects
[FDT] 7086
Find in Files
Ready
E8aDirect: (Disconnected)
UCP OFF

```
Calculating device checksum
Flash Checksum: 0x0035DDDA (User Boot Area)
Flash Checksum: 0x07F80000 (User Area)

Disconnecting
Disconnected
```

3.4 Boot Mode 2 (Write to the User Area)

Write the load module file for user program mode to the user area in boot mode.
The program written to the user area is the same file that was used in Section 3.3, “Boot Mode 1 (Write to the User Boot Area).”

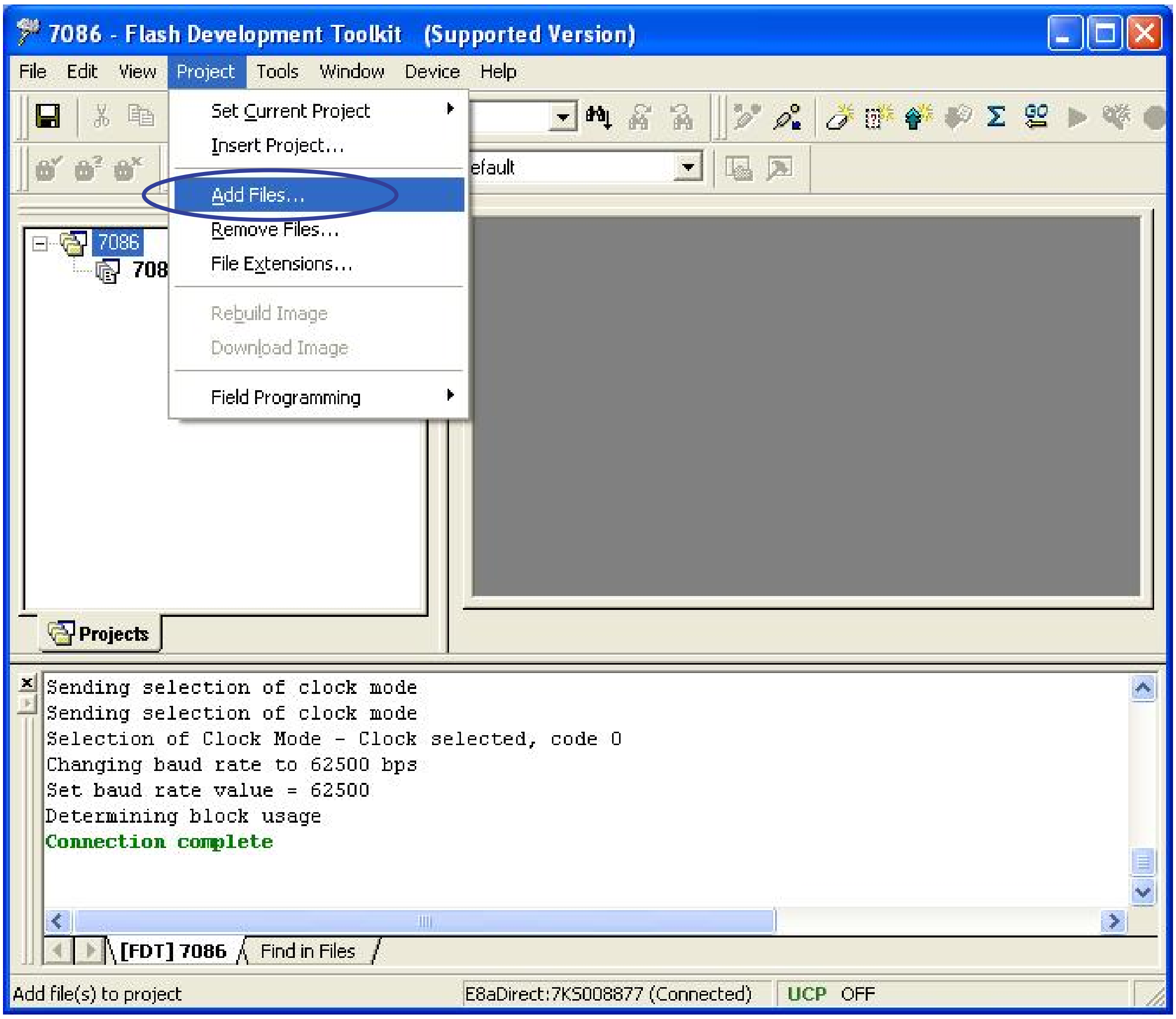
(1) Launch Flash Development Toolkit 4.01, open the project workspace file “7086.AWS,” and connect to the device.



7086 - Flash Development Toolkit (Supported Version)
File Edit View Project Tools Window Device Help
Default
Default
7086
7086
Projects
[FDT] 7086
Find in Files
E8aDirect:7KS008877 (Connected)
UCP OFF

```
Sending selection of clock mode
Sending selection of clock mode
Selection of Clock Mode - Clock selected, code 0
Changing baud rate to 62500 bps
Set baud rate value = 62500
Determining block usage
Connection complete
```

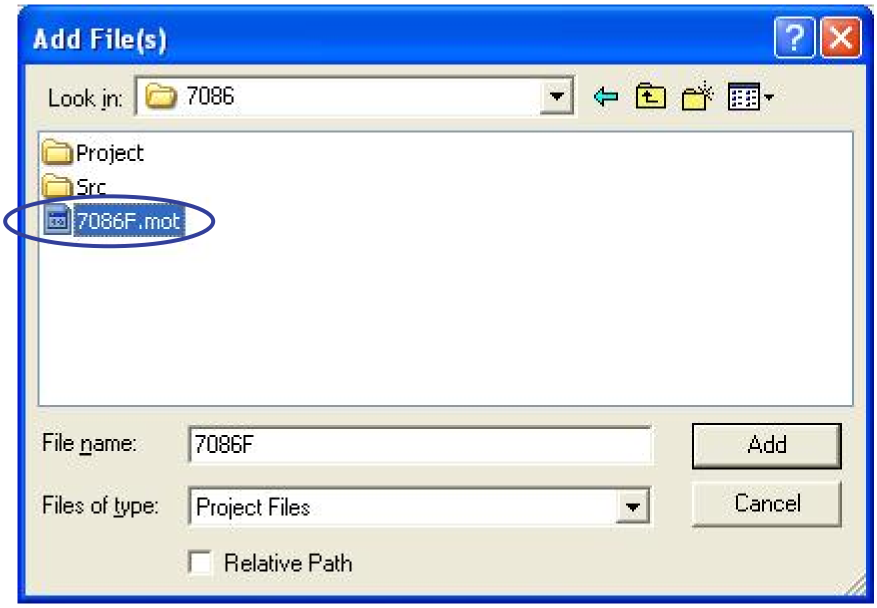
(2) Select the file to write.
Choose “Add File” from the Project menu.



```
Sending selection of clock mode
Sending selection of clock mode
Selection of Clock Mode - Clock selected, code 0
Changing baud rate to 62500 bps
Set baud rate value = 62500
Determining block usage
Connection complete
```

Add file(s) to project   E8aDirect:7KS008877 (Connected)   UCP OFF

In the Add File dialog box, select the “7086F.mot” file and click Add.



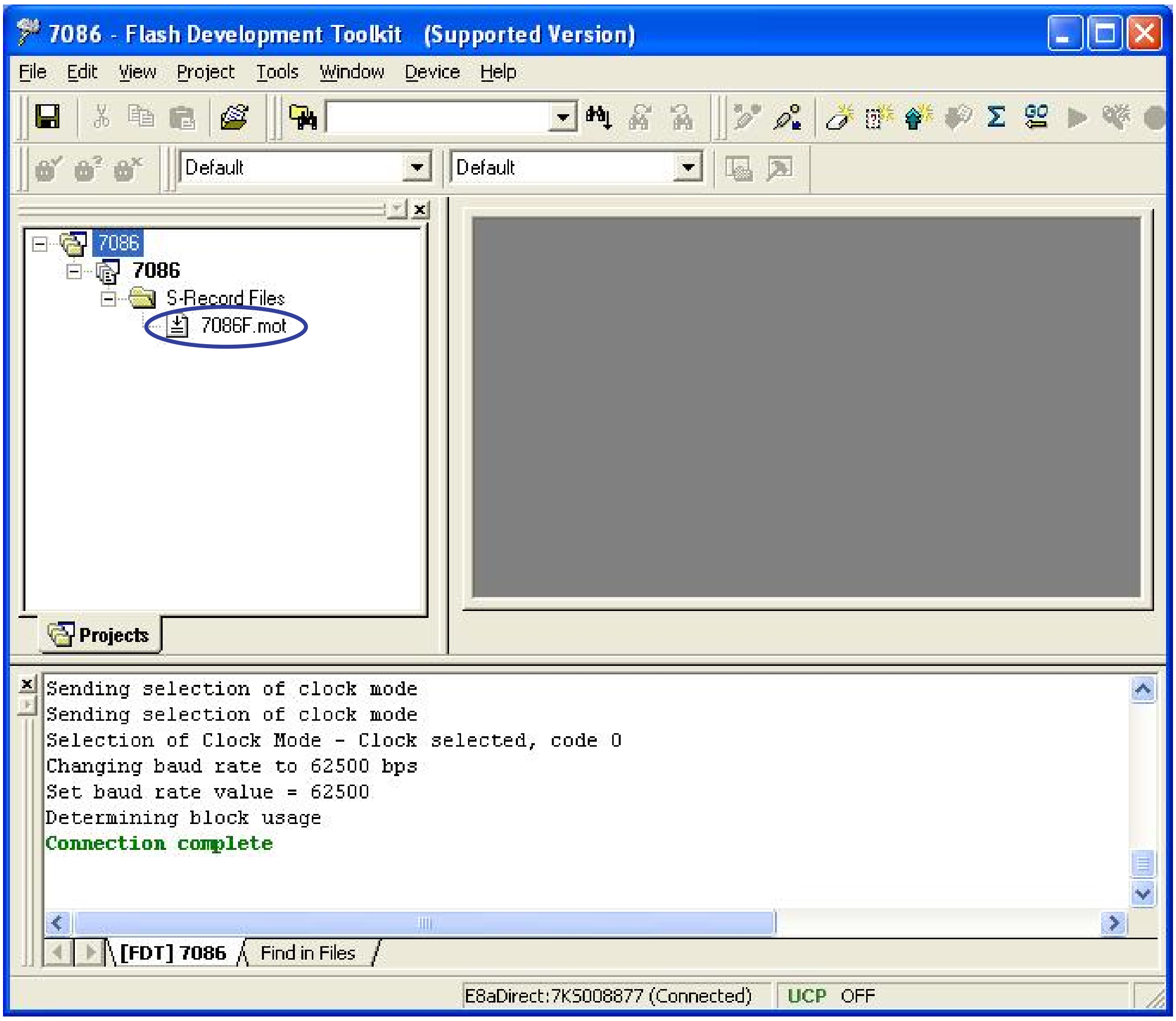
Look in: 7086

File name: 7086F

Files of type: Project Files

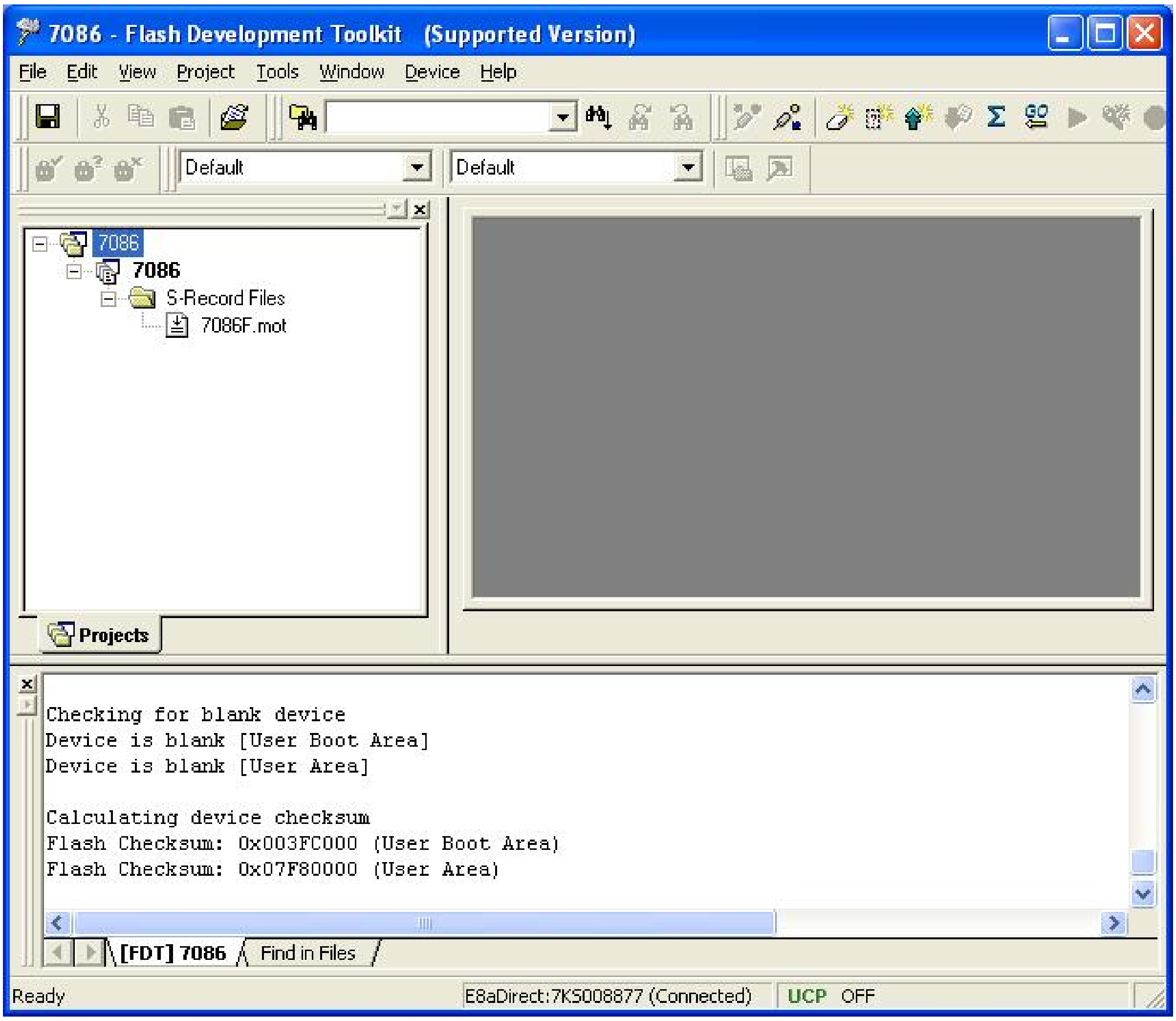
□ Relative Path

The “7086F.mot” file will be added to the project.


7086 - Flash Development Toolkit (Supported Version)
File Edit View Project Tools Window Device Help
Default
Default
7086
7086
S-Record Files
7086F.mot
Projects
[FDT] 7086
Find in Files
E8aDirect:7KS008877 (Connected)
UCP OFF

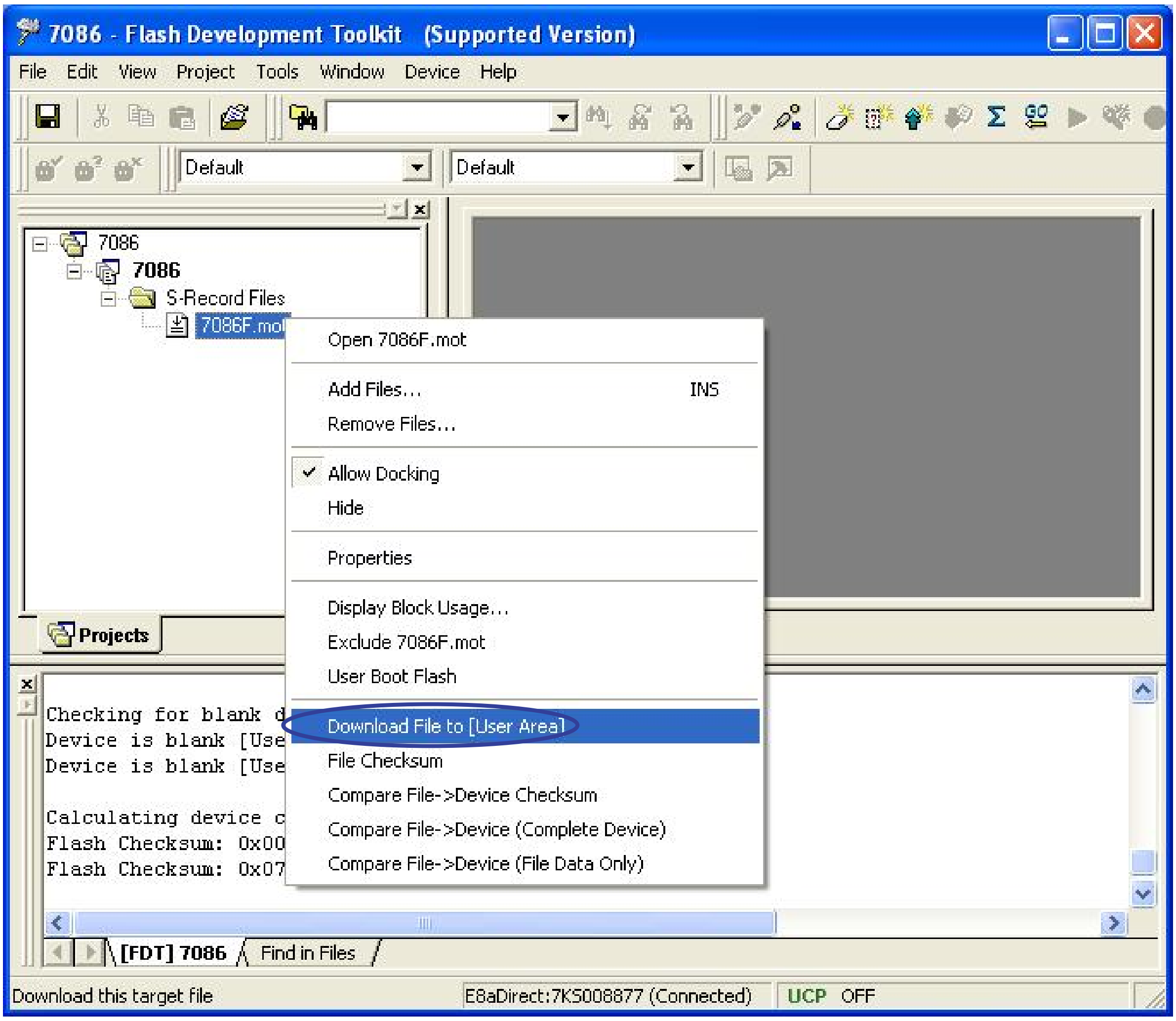
```
Sending selection of clock mode
Sending selection of clock mode
Selection of Clock Mode - Clock selected, code 0
Changing baud rate to 62500 bps
Set baud rate value = 62500
Determining block usage
Connection complete
```

(3) Before writing the 7086F.mot file to the user area, perform a blank check and a checksum.
Choose “Blank Check” from the Device menu.
Choose “Flash Checksum” from the Device menu.
The results of a blank check and a checksum will be displayed.


7086 - Flash Development Toolkit (Supported Version)
File Edit View Project Tools Window Device Help
Default
Default
7086
7086
S-Record Files
7086F.mot
Projects
[FDT] 7086
Find in Files
Ready
E8aDirect:7KS008877 (Connected)
UCP OFF

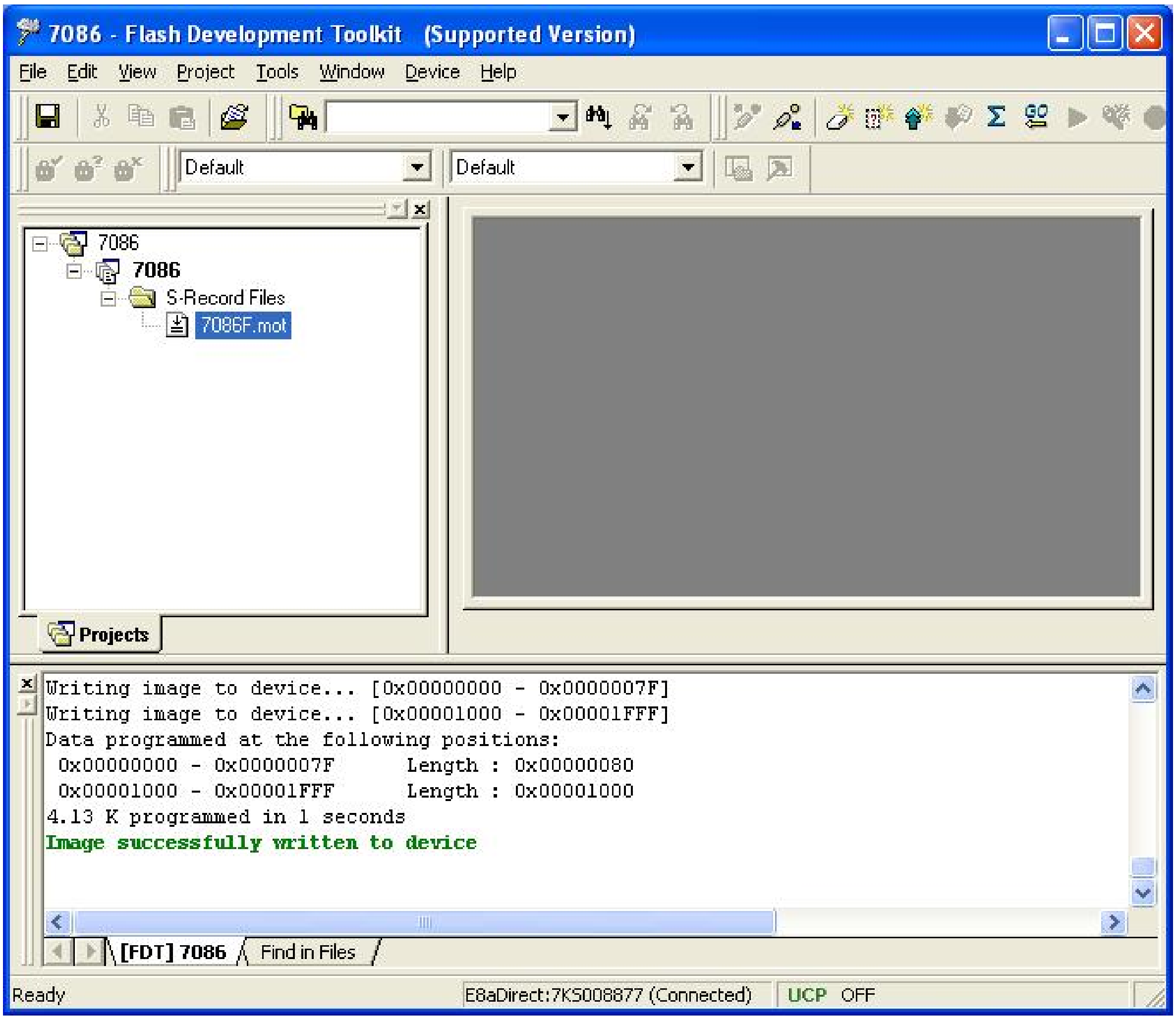
```
Checking for blank device
Device is blank [User Boot Area]
Device is blank [User Area]

Calculating device checksum
Flash Checksum: 0x003FC000 (User Boot Area)
Flash Checksum: 0x07F80000 (User Area)
```

(4) Right-click the 7086F.mot file, and from the popup menu choose “Download [User Area]” to download the 7086F.mot file into the user area.
The default is “Download [User Area].”



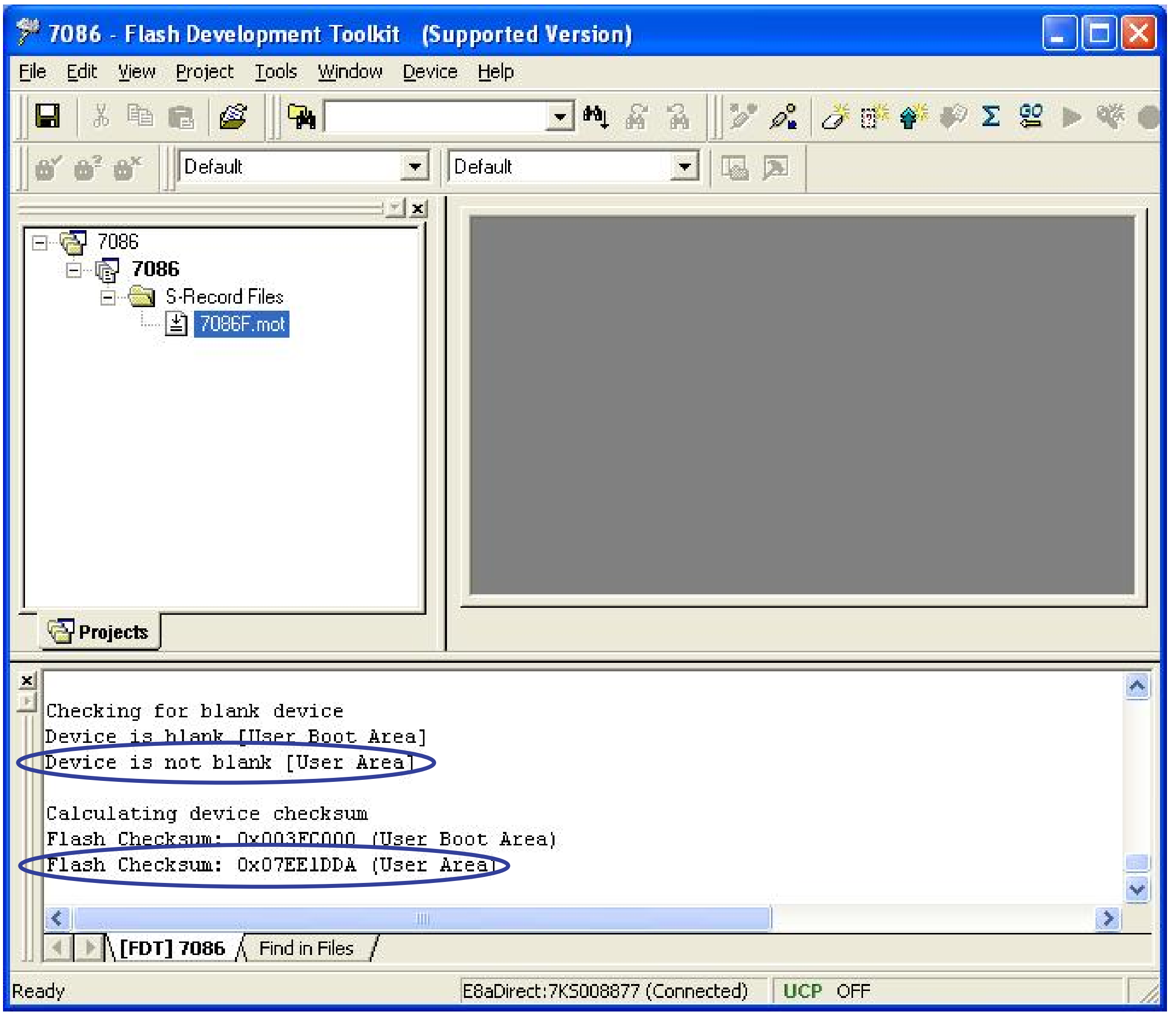
```
Checking for blank d
Device is blank [Use
Device is blank [Use

Calculating device c
Flash Checksum: 0x00
Flash Checksum: 0x07
```

The program has been downloaded into the user area.


7086 - Flash Development Toolkit (Supported Version)
File Edit View Project Tools Window Device Help
Default
Default
7086
7086
S-Record Files
7086F.mot
Projects
[FDT] 7086
Find in Files
Ready
E8aDirect:7KS008877 (Connected)
UCP OFF

```
Writing image to device... [0x00000000 - 0x0000007F]
Writing image to device... [0x00001000 - 0x00001FFF]
Data programmed at the following positions:
 0x00000000 - 0x0000007F      Length : 0x00000080
 0x00001000 - 0x00001FFF      Length : 0x00001000
4.13 K programmed in 1 seconds
Image successfully written to device
```

(5) To verify that the program has been written to the user area, perform a blank check and a checksum.
Choose “Blank Check” from the Device menu.
Choose “Flash Checksum” from the Device menu.
The results of a blank check and a checksum will be displayed.


7086 - Flash Development Toolkit (Supported Version)
File Edit View Project Tools Window Device Help
Default
Default
7086
7086
S-Record Files
7086F.mot
Projects
[FDT] 7086
Find in Files
Ready
E8aDirect:7KS008877 (Connected)
UCP OFF

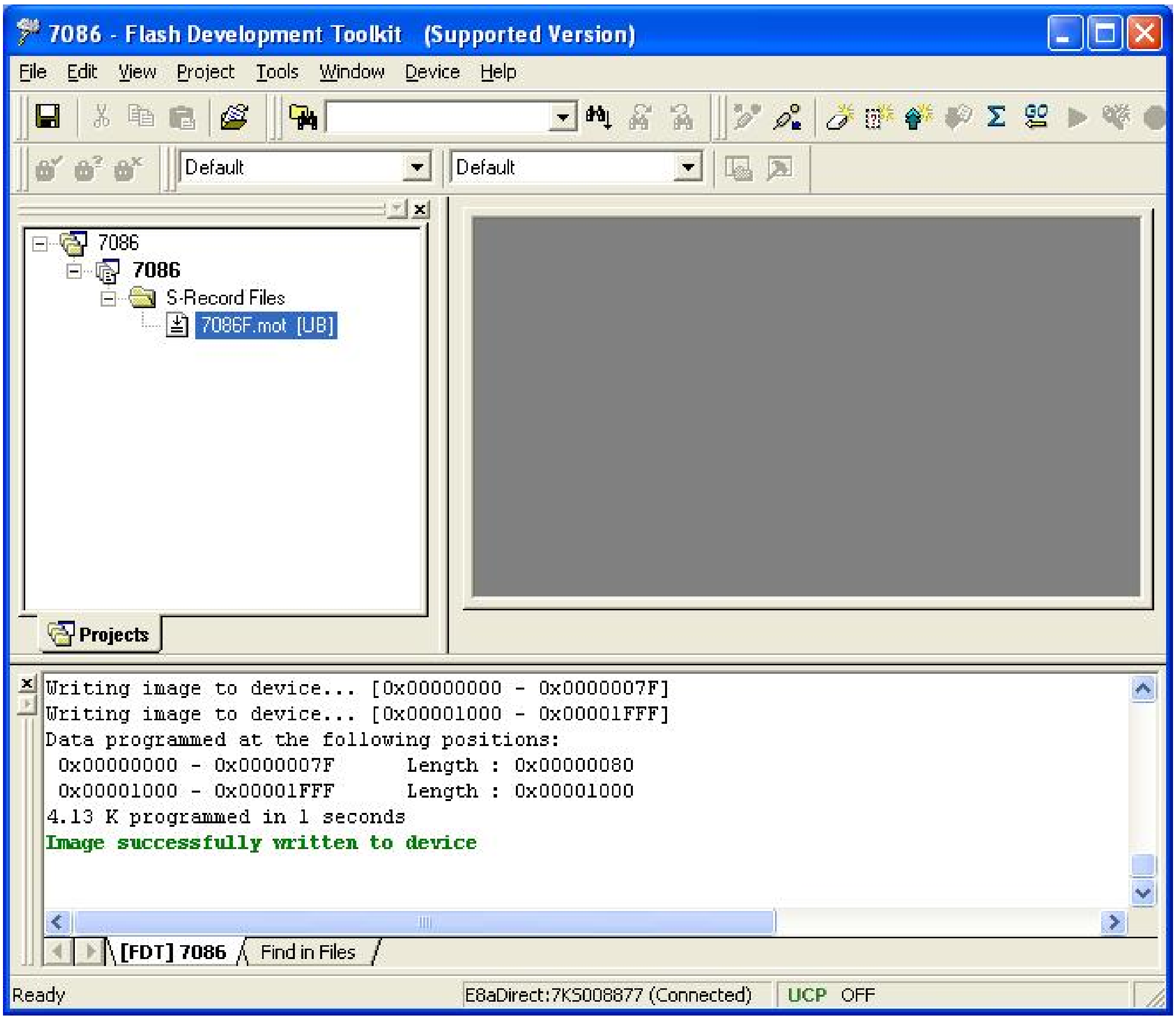
```
Checking for blank device
Device is blank [User Boot Area]
Device is not blank [User Area]

Calculating device checksum
Flash Checksum: 0x003FC000 (User Boot Area)
Flash Checksum: 0x07EE1DDA (User Area)
```

The result shows that the program has been written to the user area.

3.5 User Boot Mode

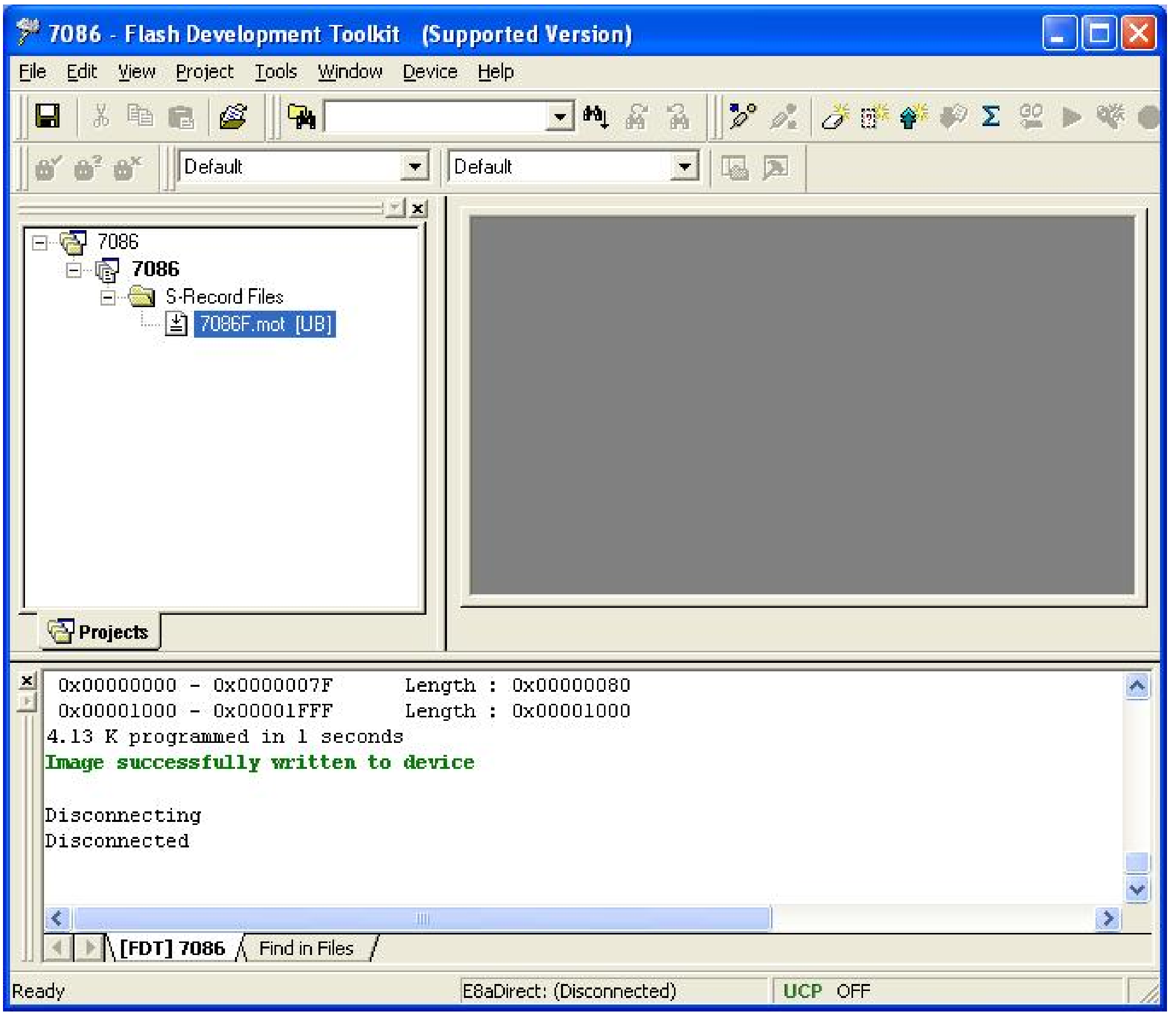
In user boot mode, it is possible to write to and erase the user area. This mode does not allow writing to and erasing the user boot area. Therefore, it is necessary that the load module file for user program mode be written in the user boot area beforehand.

(1) Launch Flash Development Toolkit 4.01, open the project workspace file “7086.AWS,” and write the 7086F.mot file to the user boot area in boot mode.


7086 - Flash Development Toolkit (Supported Version)
File Edit View Project Tools Window Device Help
Default
Default
7086
7086
S-Record Files
7086F.mot [UB]
Projects
[FDT] 7086
Find in Files
Ready
E8aDirect:7KS008877 (Connected)
UCP OFF

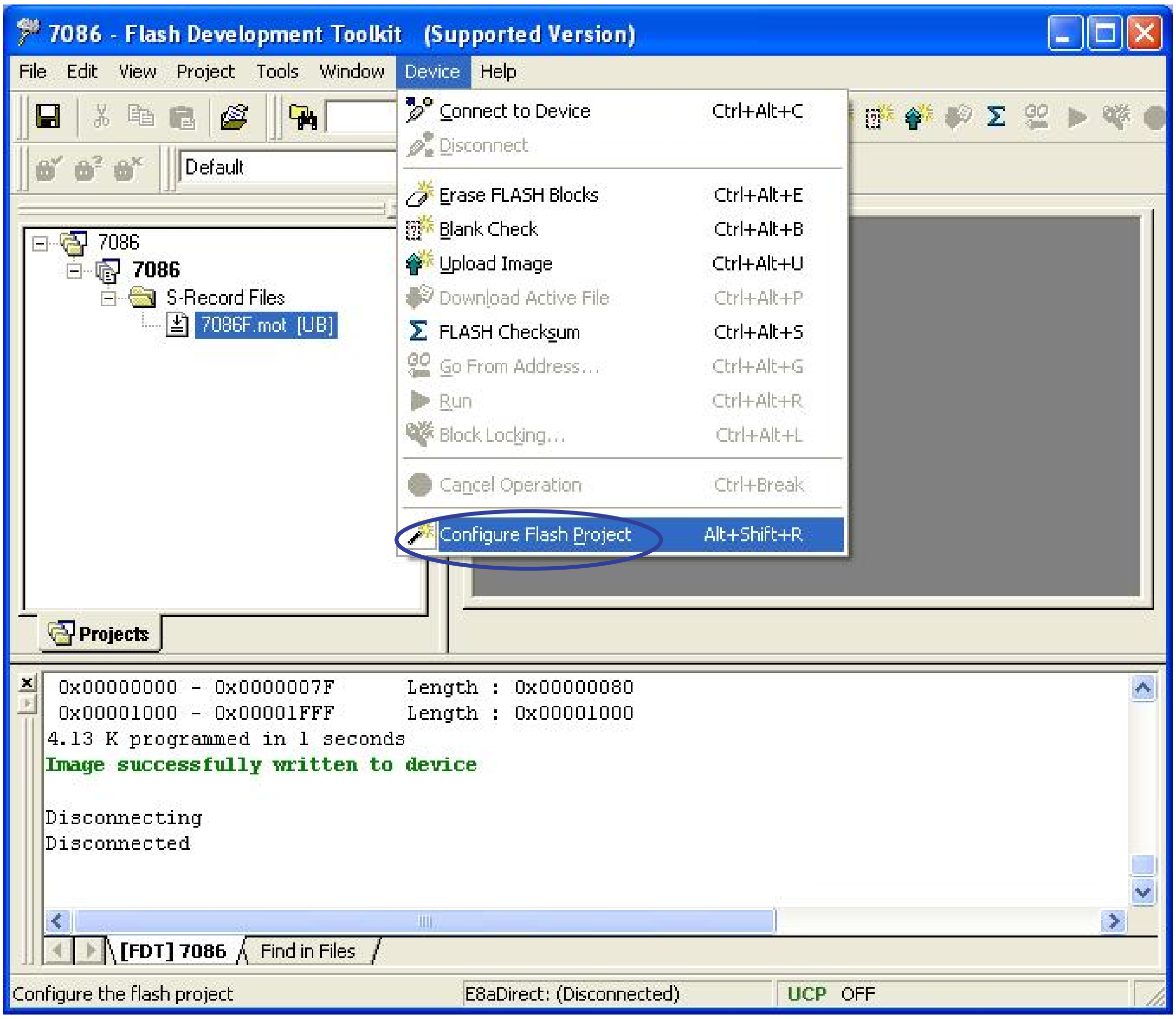
```
Writing image to device... [0x00000000 - 0x0000007F]
Writing image to device... [0x00001000 - 0x00001FFF]
Data programmed at the following positions:
 0x00000000 - 0x0000007F      Length : 0x00000080
 0x00001000 - 0x00001FFF      Length : 0x00001000
4.13 K programmed in 1 seconds
Image successfully written to device
```

(2) Choose “Disconnect from Device” from the Device menu to disconnect the device.


7086 - Flash Development Toolkit (Supported Version)
File Edit View Project Tools Window Device Help
Default
Default
7086
7086
S-Record Files
7086F.mot [UB]
Projects
[FDT] 7086
Find in Files
Ready
E8aDirect: (Disconnected)
UCP OFF

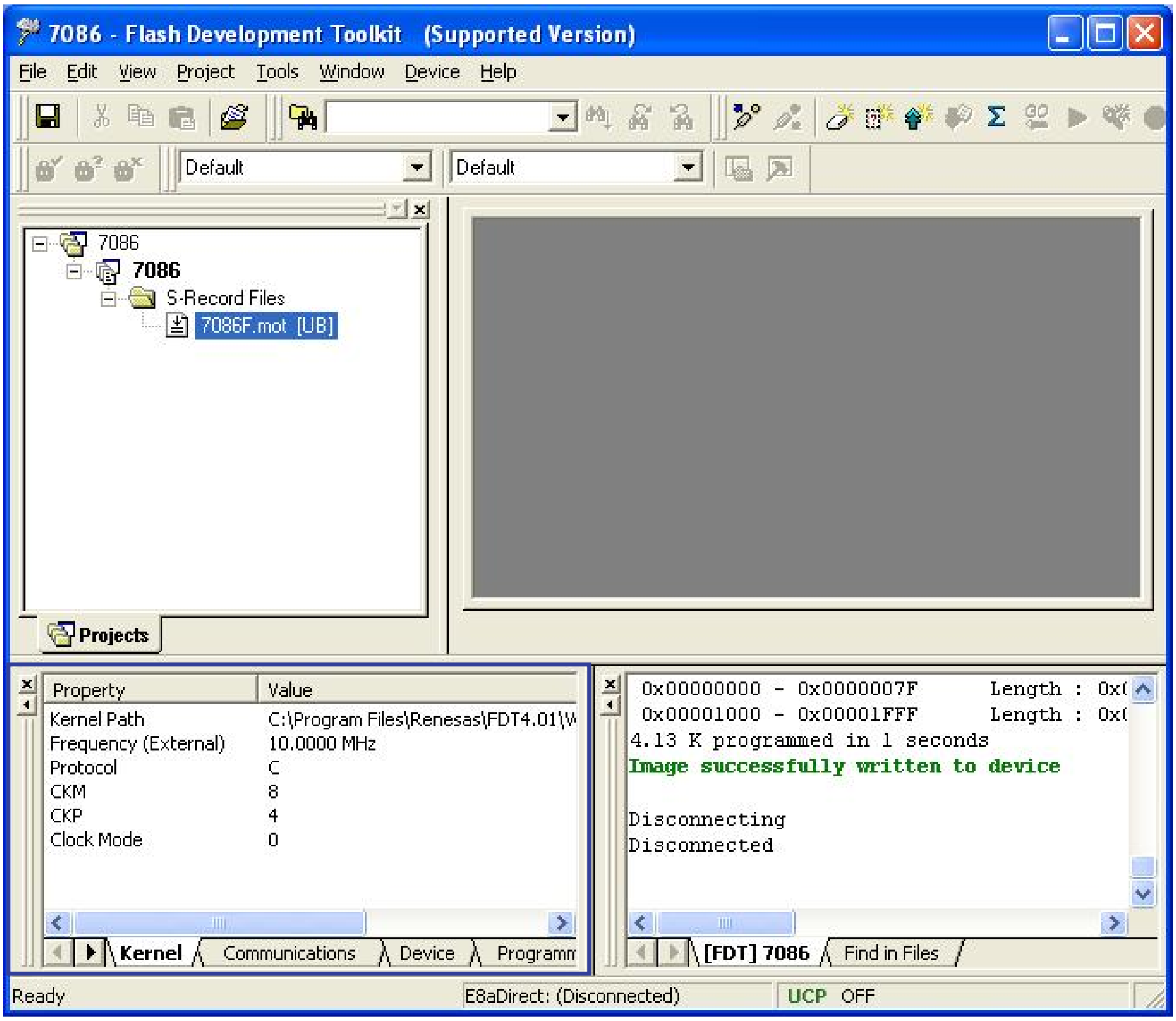
```
 0x00000000 - 0x0000007F      Length : 0x00000080
 0x00001000 - 0x00001FFF      Length : 0x00001000
4.13 K programmed in 1 seconds
Image successfully written to device

Disconnecting
Disconnected
```

(3) Choose “Project Setting” from the Device menu.


7086 - Flash Development Toolkit (Supported Version)
File Edit View Project Tools Window Device Help
Connect to Device Ctrl+Alt+C
Disconnect
Erase FLASH Blocks Ctrl+Alt+E
Blank Check Ctrl+Alt+B
Upload Image Ctrl+Alt+U
Download Active File Ctrl+Alt+P
FLASH Checksum Ctrl+Alt+S
Go From Address... Ctrl+Alt+G
Run Ctrl+Alt+R
Block Locking... Ctrl+Alt+L
Cancel Operation Ctrl+Break
Configure Flash Project Alt+Shift+R
Default
7086
7086
S-Record Files
7086F.mot [UB]
Projects
[FDT] 7086
Find in Files
Configure the flash project
E8aDirect: (Disconnected)
UCP OFF

```
 0x00000000 - 0x0000007F      Length : 0x00000080
 0x00001000 - 0x00001FFF      Length : 0x00001000
4.13 K programmed in 1 seconds
Image successfully written to device

Disconnecting
Disconnected
```

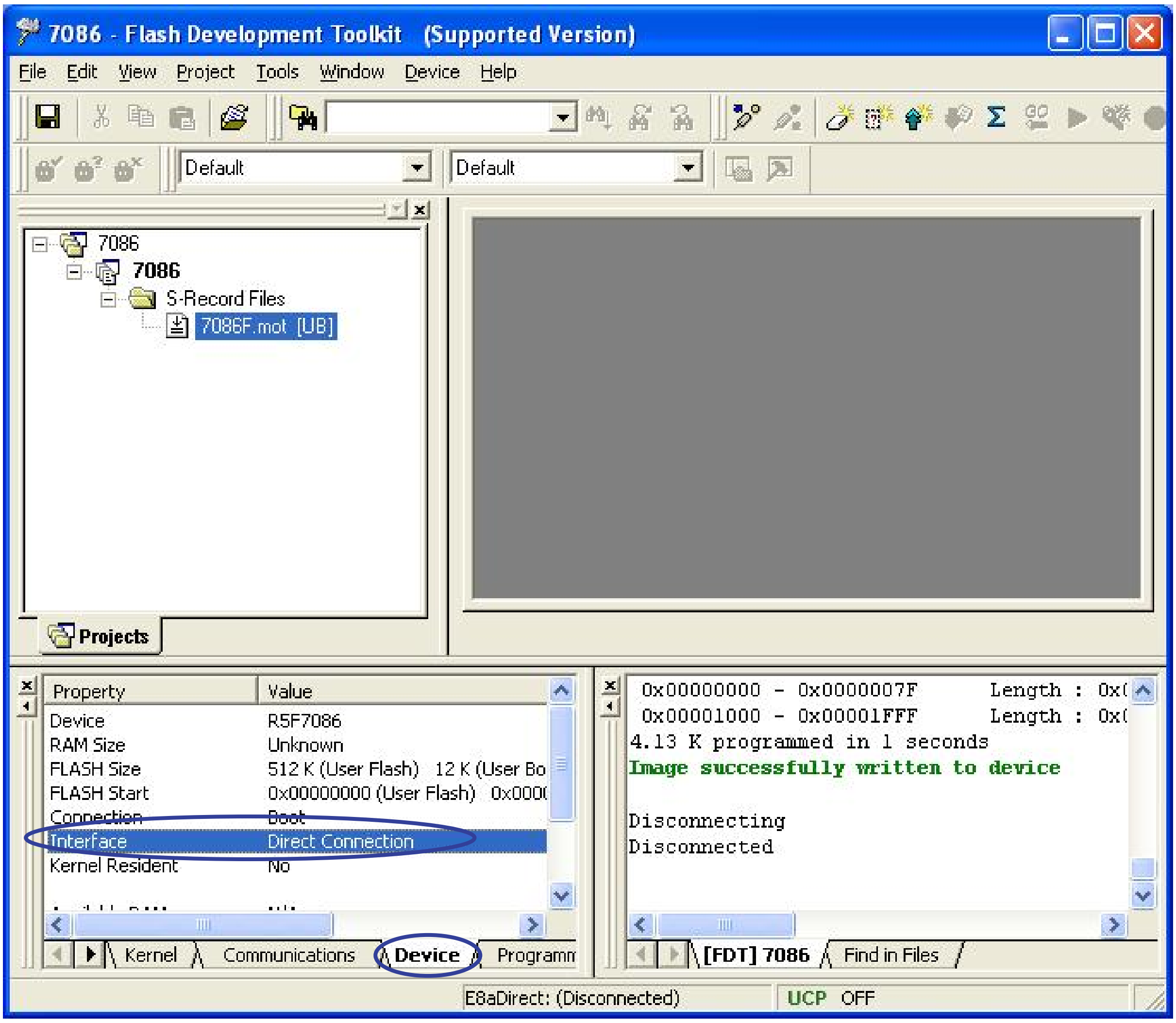
The project setting window will be displayed.



Property	Value
Kernel Path	C:\Program Files\Renesas\FDT4.01\W
Frequency (External)	10.0000 MHz
Protocol	C
CKM	8
CKP	4
Clock Mode	0

```
 0x00000000 - 0x0000007F      Length : 0x(
 0x00001000 - 0x00001FFF      Length : 0x(
4.13 K programmed in 1 seconds
Image successfully written to device

Disconnecting
Disconnected
```

(4) Set up the user boot mode.
Select the Device tab of the project setup window and double-click the “Interface Direct Connection” line.

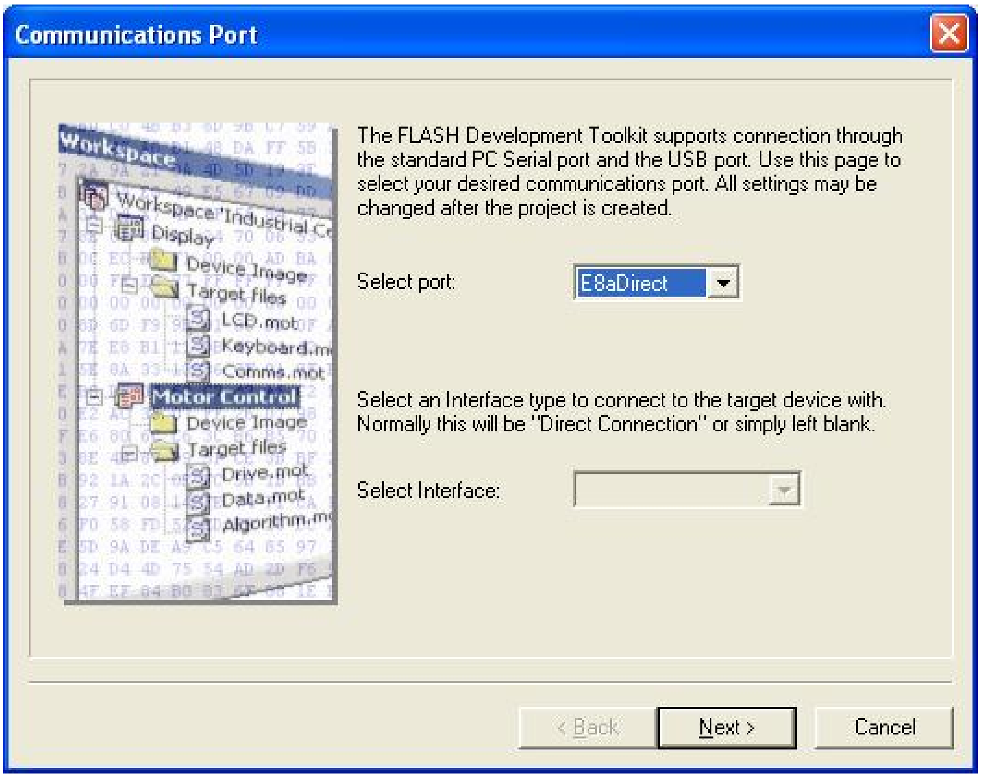


Property	Value
Device	R5F7086
RAM Size	Unknown
FLASH Size	512 K (User Flash) 12 K (User Bo
FLASH Start	0x00000000 (User Flash) 0x0000
Connection	Boot
Interface	Direct Connection
Kernel Resident	No

```
 0x00000000 - 0x0000007F      Length : 0x(
 0x00001000 - 0x00001FFF      Length : 0x(
4.13 K programmed in 1 seconds
Image successfully written to device

Disconnecting
Disconnected
```

E8aDirect: (Disconnected) UCP OFF

Click Next.



Communications Port

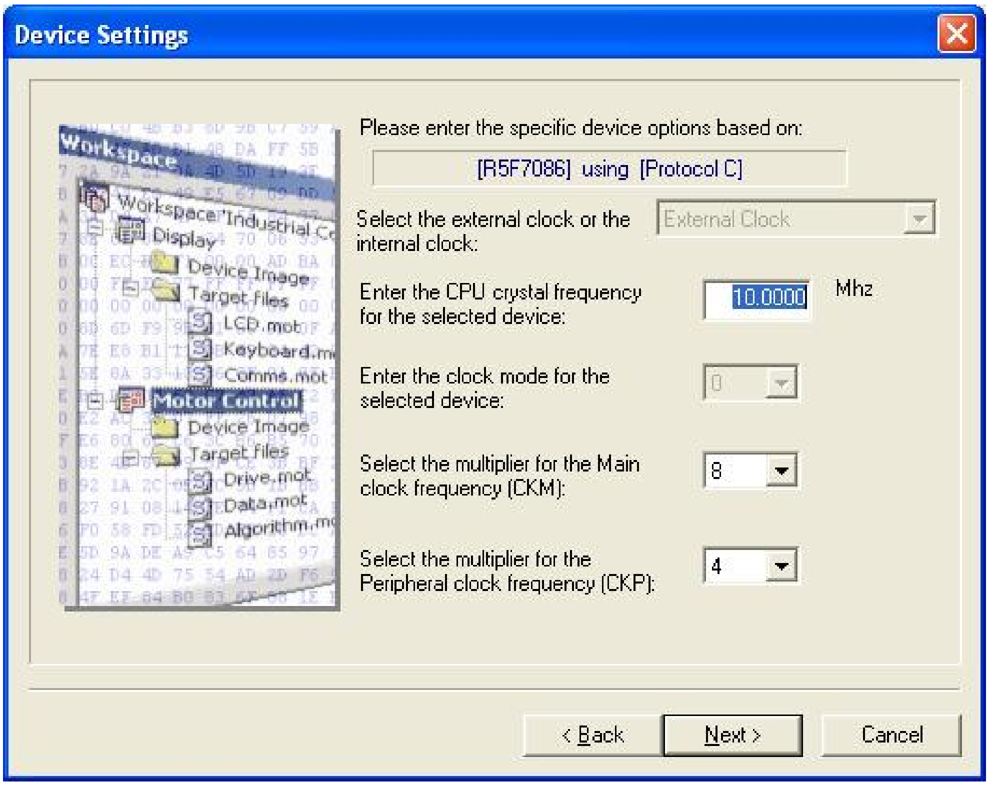
The FLASH Development Toolkit supports connection through the standard PC Serial port and the USB port. Use this page to select your desired communications port. All settings may be changed after the project is created.

Select port: E8aDirect

Select an Interface type to connect to the target device with. Normally this will be "Direct Connection" or simply left blank.

Select Interface:

Click Next.



Device Settings

Please enter the specific device options based on:

[R5F7086] using [Protocol C]

Select the external clock or the internal clock: External Clock

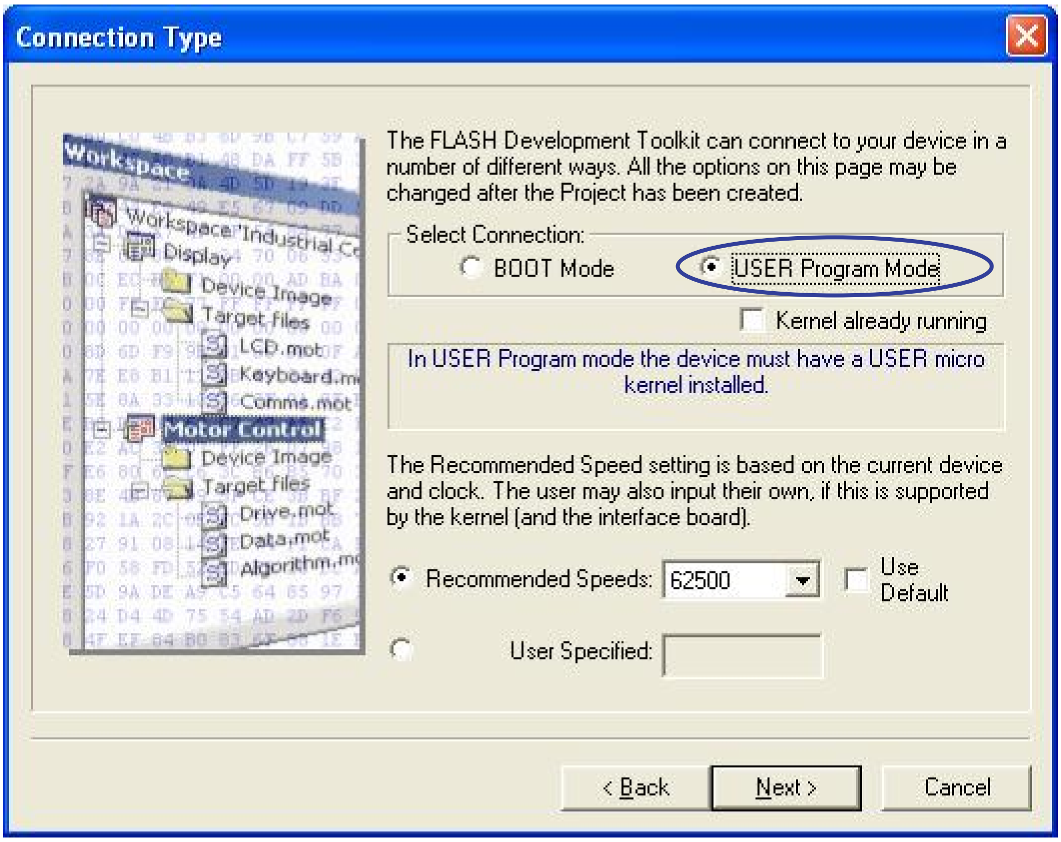
Enter the CPU crystal frequency for the selected device: 10.0000 Mhz

Enter the clock mode for the selected device: 0

Select the multiplier for the Main clock frequency (CKM): 8

Select the multiplier for the Peripheral clock frequency (CKP): 4

In the Select Connection column, select “USER Program Mode” and then click Next.



Connection Type

The FLASH Development Toolkit can connect to your device in a number of different ways. All the options on this page may be changed after the Project has been created.

Select Connection:

○ BOOT Mode ● USER Program Mode

□ Kernel already running

In USER Program mode the device must have a USER micro kernel installed.

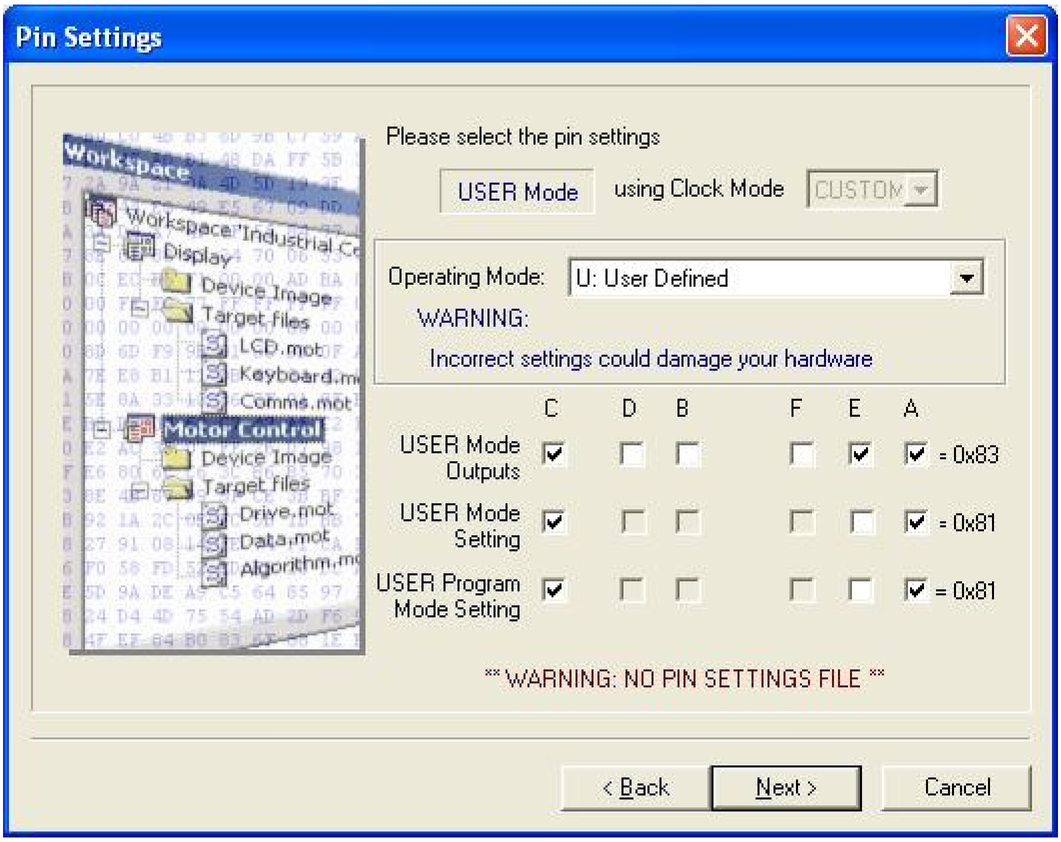
The Recommended Speed setting is based on the current device and clock. The user may also input their own, if this is supported by the kernel (and the interface board).

● Recommended Speeds: 62500 □ Use Default

○ User Specified:

Set up the E8a pins for user boot mode.
Set pin C (FWE) and pin A (MD0) to 1 and pin E (MD1) to 0, respectively and then click OK.

	Pin Setting			
Mode No.	FWE	MD1	MD0	Mode Name
Mode 5	1	0	1	User boot mode



Pin Settings

Please select the pin settings

USER Mode using Clock Mode CUSTOM

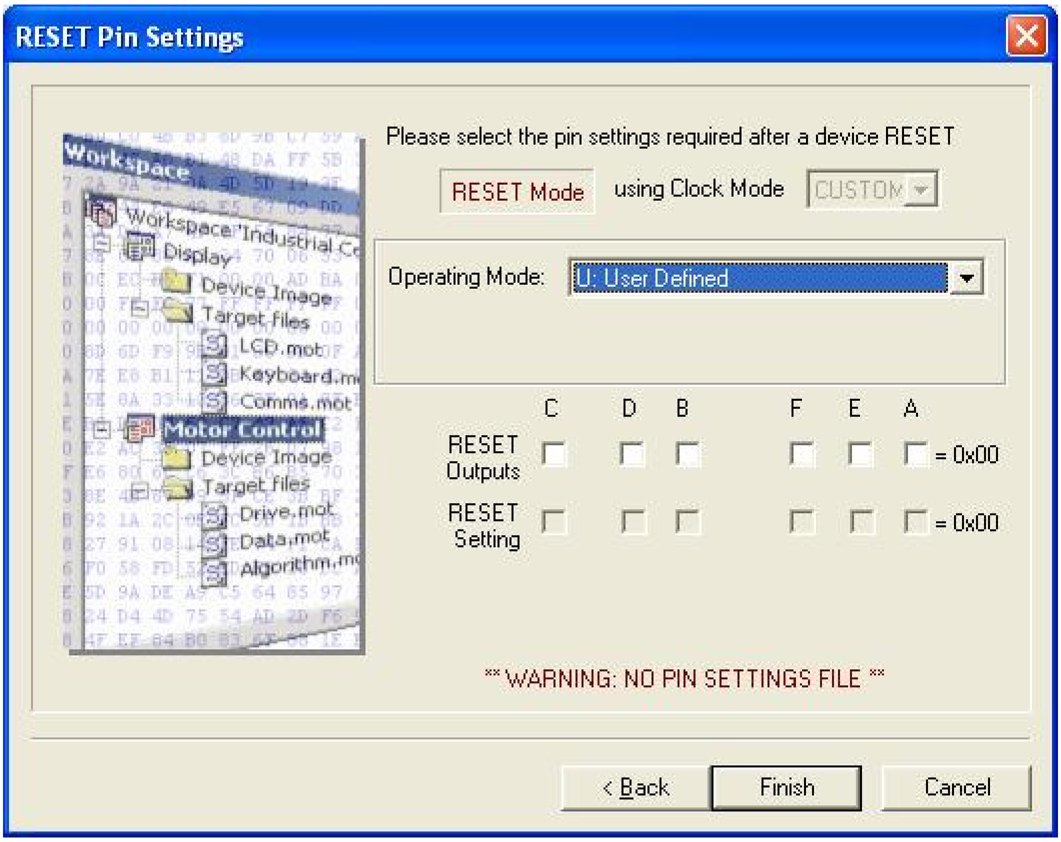
Operating Mode: U: User Defined

WARNING:
Incorrect settings could damage your hardware

	C	D	B	F	E	A	
USER Mode Outputs	☑	□	□	□	☑	☑	= 0x83
USER Mode Setting	☑	□	□	□	□	☑	= 0x81
USER Program Mode Setting	☑	□	□	□	□	☑	= 0x81

** WARNING: NO PIN SETTINGS FILE **

Click the Finish button.



RESET Pin Settings

Please select the pin settings required after a device RESET

RESET Mode using Clock Mode CUSTOM

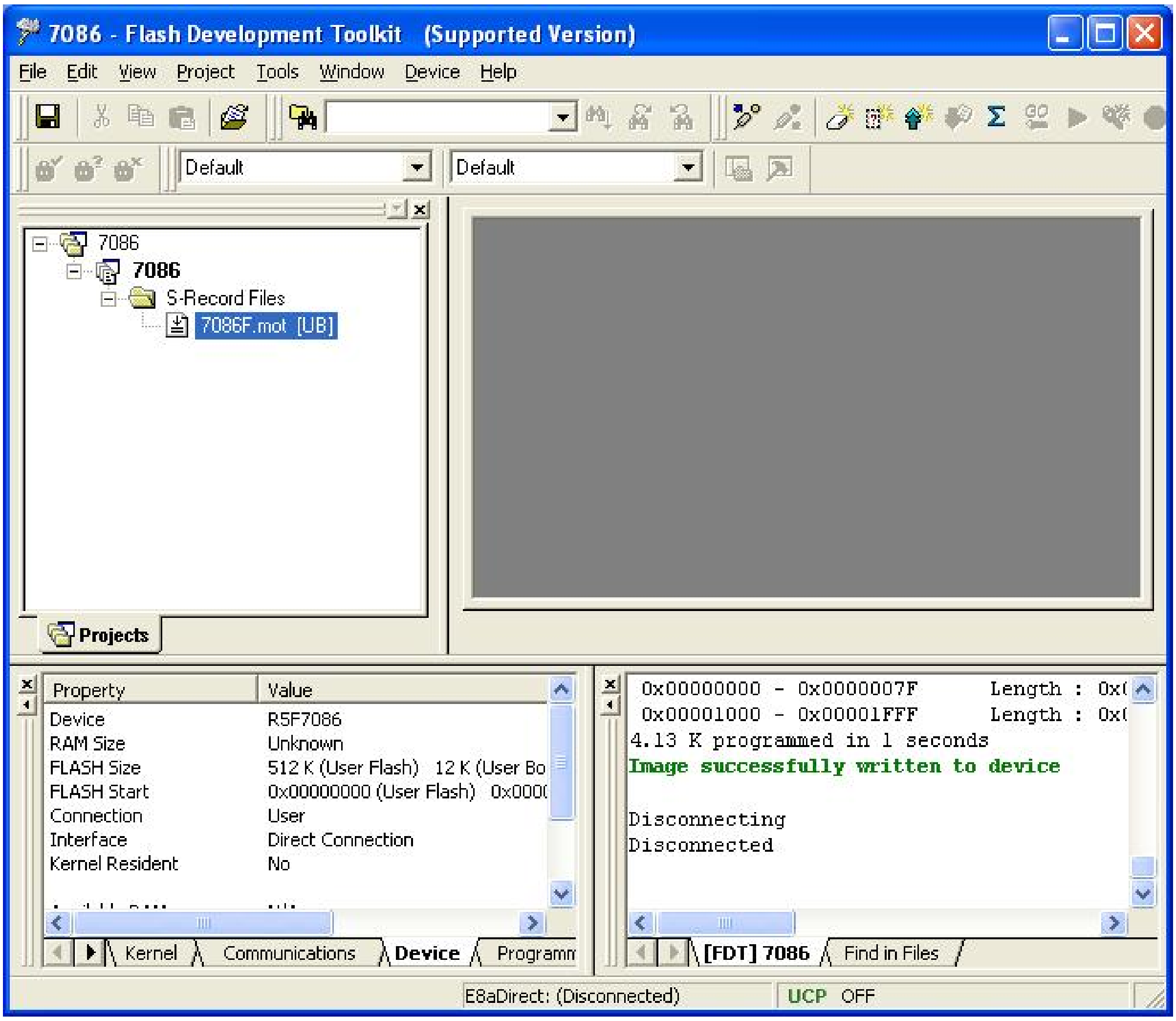
Operating Mode: U: User Defined

	C	D	B	F	E	A	
RESET Outputs	□	□	□	□	□	□	= 0x00
RESET Setting	□	□	□	□	□	□	= 0x00

** WARNING: NO PIN SETTINGS FILE **

< Back | Finish | Cancel

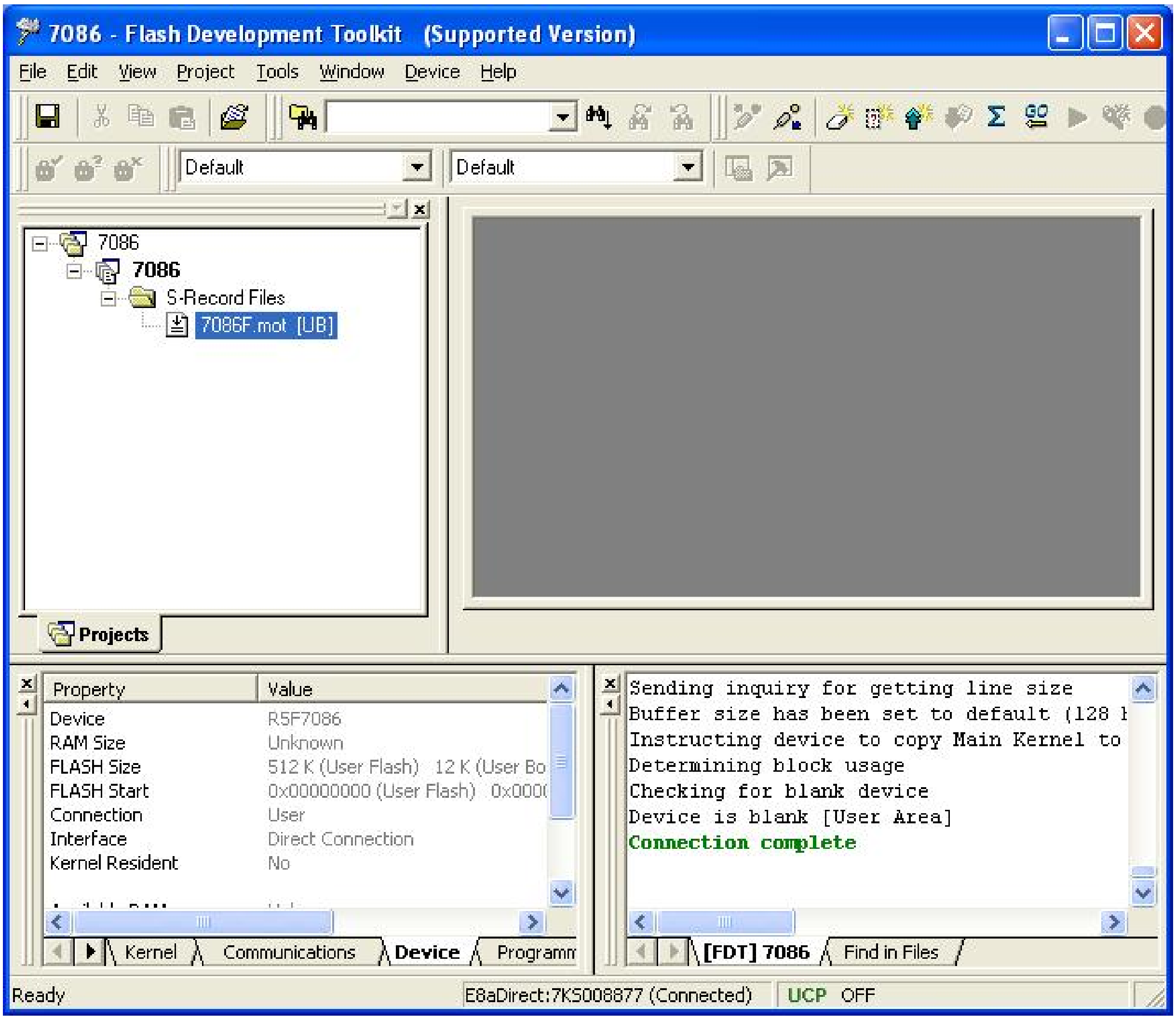
The user boot mode has been set up.


7086 - Flash Development Toolkit (Supported Version)
File Edit View Project Tools Window Device Help
Default
Default
7086
7086
S-Record Files
7086F.mot [UB]
Projects
Kernel
Communications
Device
Programm
[FDT] 7086
Find in Files
E8aDirect: (Disconnected)
UCP OFF

Property	Value
Device	R5F7086
RAM Size	Unknown
FLASH Size	512 K (User Flash) 12 K (User Bo
FLASH Start	0x00000000 (User Flash) 0x0000(
Connection	User
Interface	Direct Connection
Kernel Resident	No

```
 0x00000000 - 0x0000007F      Length : 0x(
 0x00001000 - 0x00001FFF      Length : 0x(
4.13 K programmed in 1 seconds
Image successfully written to device

Disconnecting
Disconnected
```

(5) Choose “Connect to Device” from the Device menu to connect the device.

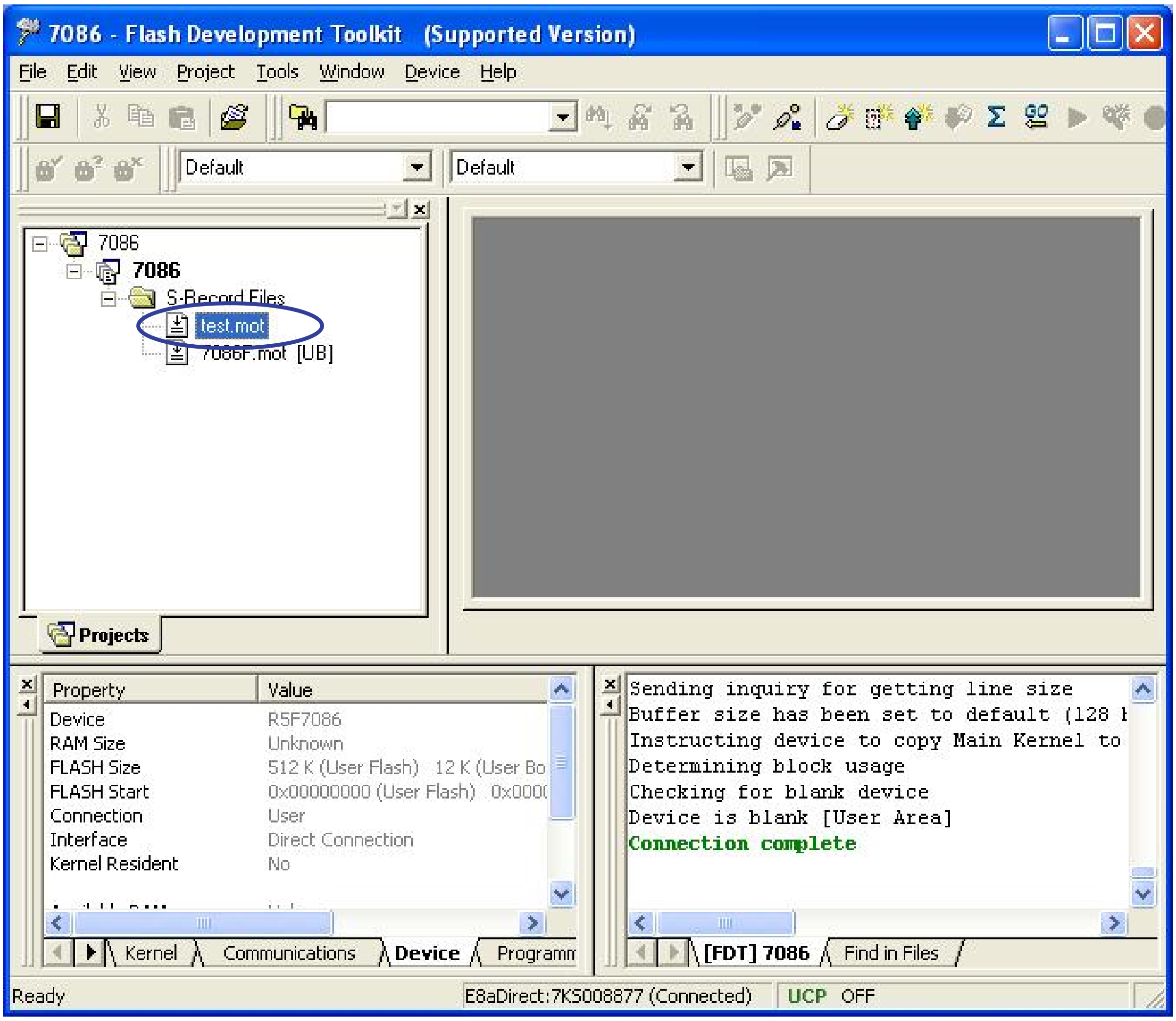


Property	Value
Device	R5F7086
RAM Size	Unknown
FLASH Size	512 K (User Flash) 12 K (User Bo
FLASH Start	0x00000000 (User Flash) 0x0000(
Connection	User
Interface	Direct Connection
Kernel Resident	No

```
Sending inquiry for getting line size
Buffer size has been set to default (128 b
Instructing device to copy Main Kernel to
Determining block usage
Checking for blank device
Device is blank [User Area]
Connection complete
```

Ready | E8aDirect:7KS008877 (Connected) | UCP OFF

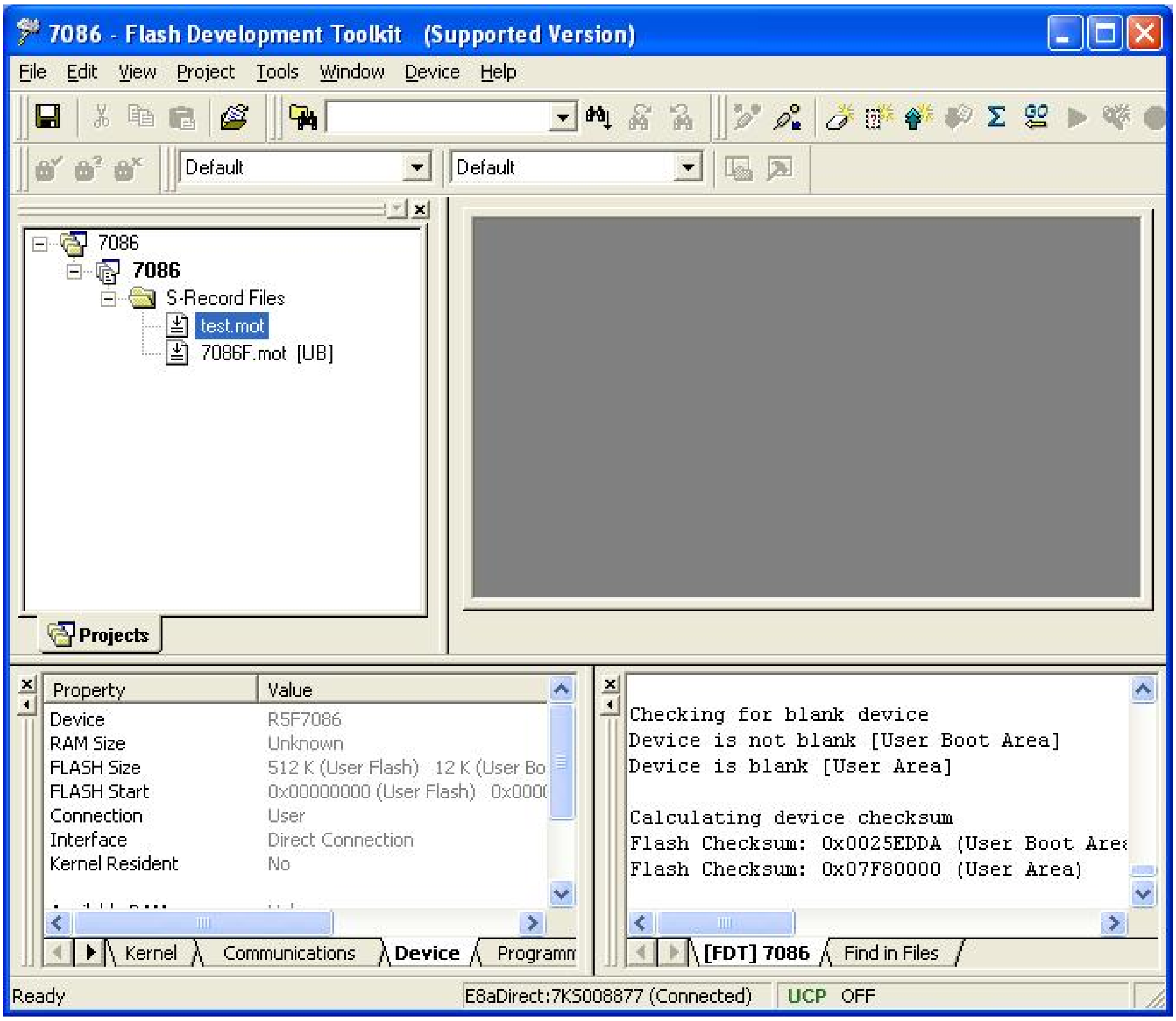
(6) Add the program to write to the user area. Here, write the test_mot file to the user area.



Property	Value
Device	R5F7086
RAM Size	Unknown
FLASH Size	512 K (User Flash) 12 K (User Bo
FLASH Start	0x00000000 (User Flash) 0x0000
Connection	User
Interface	Direct Connection
Kernel Resident	No

```
Sending inquiry for getting line size
Buffer size has been set to default (128 b
Instructing device to copy Main Kernel to
Determining block usage
Checking for blank device
Device is blank [User Area]
Connection complete
```

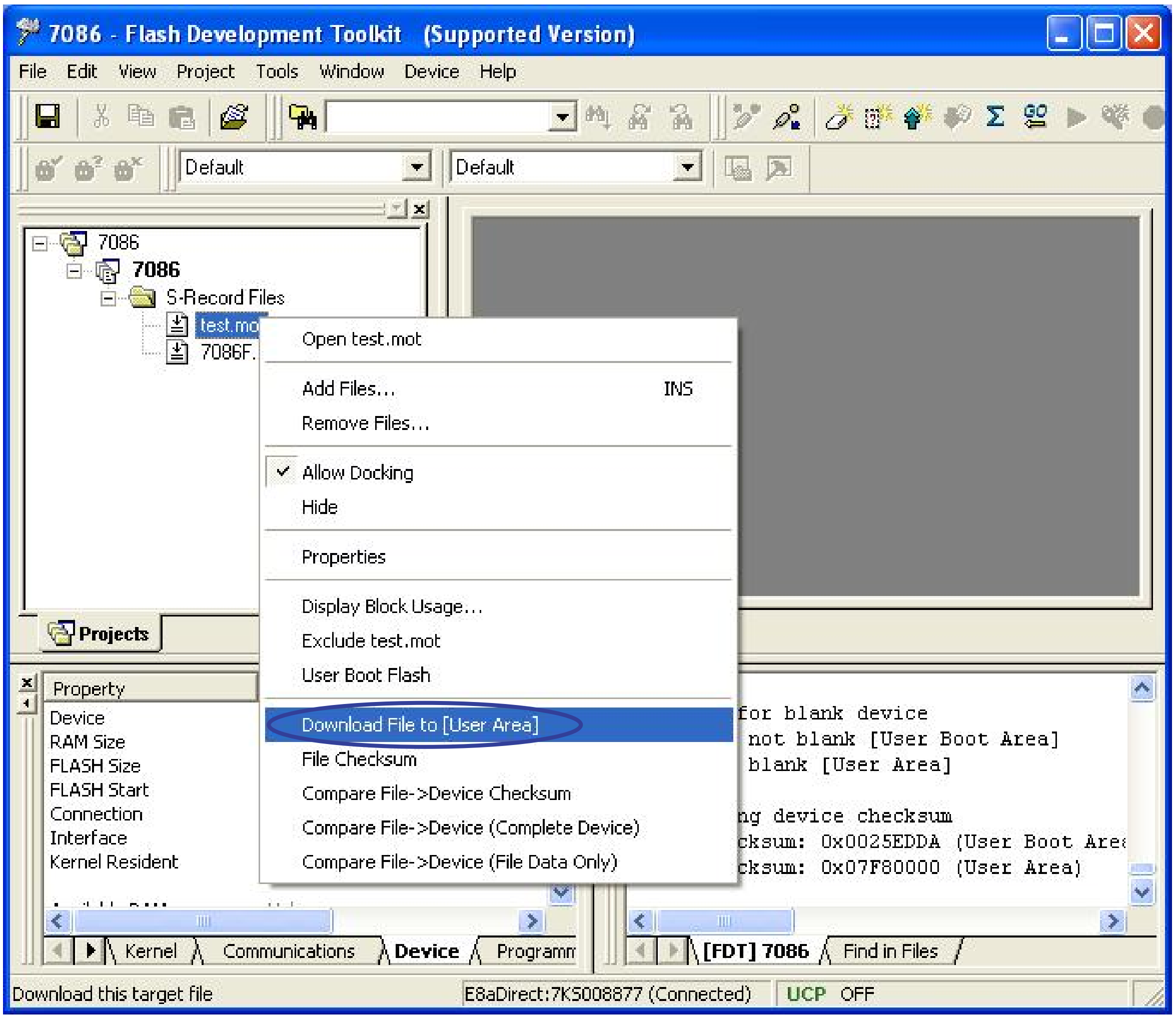
(7) Before writing the test_mot file to the user area, perform a blank check and a checksum.
Choose “Blank Check” from the Device menu.
Choose “Flash Checksum” from the Device menu.
The results of a blank check and a checksum will be displayed.



Property	Value
Device	R5F7086
RAM Size	Unknown
FLASH Size	512 K (User Flash) 12 K (User Bo
FLASH Start	0x00000000 (User Flash) 0x0000
Connection	User
Interface	Direct Connection
Kernel Resident	No

```
Checking for blank device
Device is not blank [User Boot Area]
Device is blank [User Area]

Calculating device checksum
Flash Checksum: 0x0025EDDA (User Boot Are
Flash Checksum: 0x07F80000 (User Area)
```

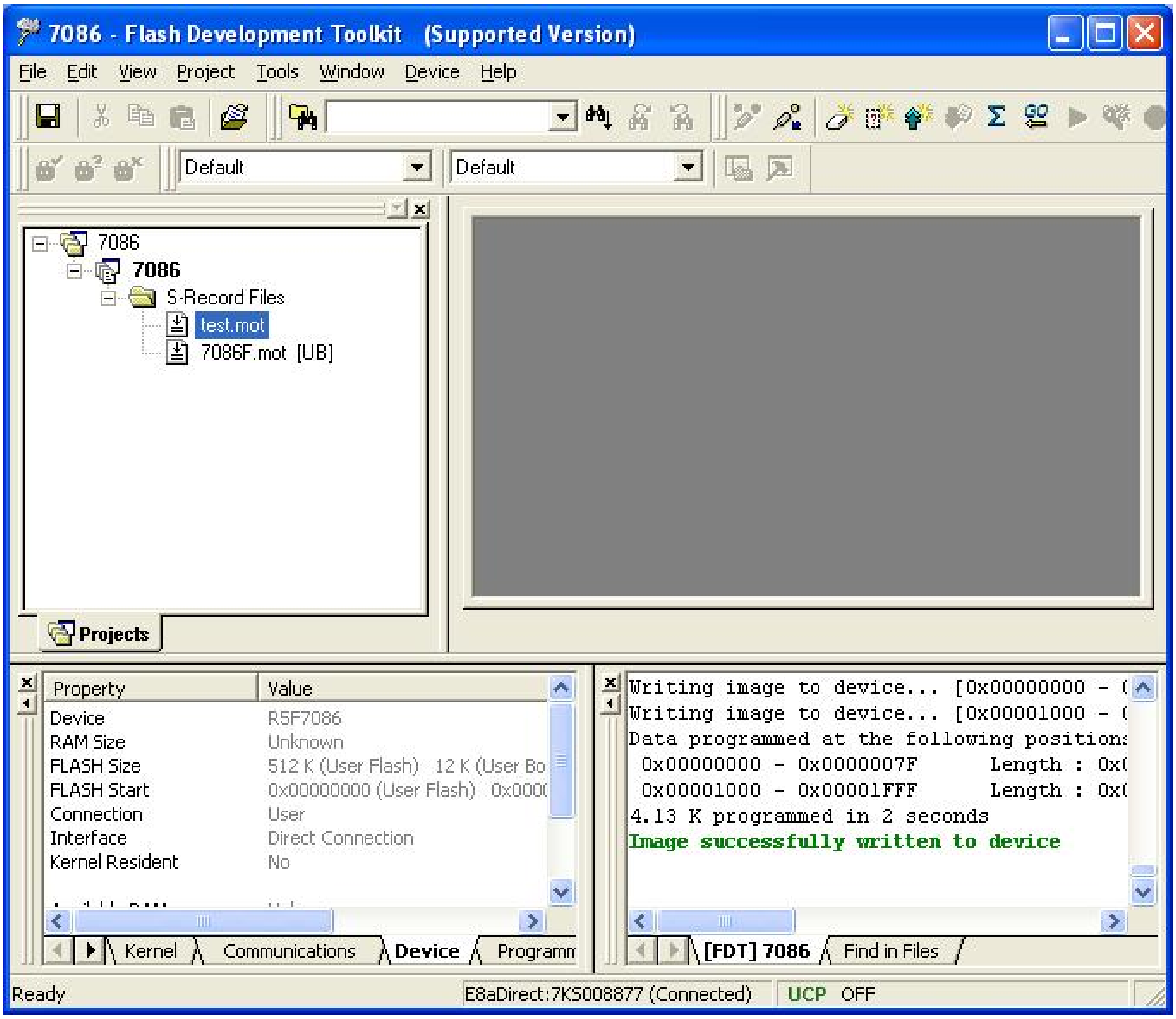
(8) Write to the user area in user boot mode.
Right-click the test_mot file, and from the popup menu choose “Download [User Area]” to download the test_mot file into the user area.



```
for blank device
 not blank [User Boot Area]
 blank [User Area]

ng device checksum
cksum: 0x0025EDDA (User Boot Area
cksum: 0x07F80000 (User Area)
```

Download this target file   E8aDirect:7KS008877 (Connected)   UCP OFF

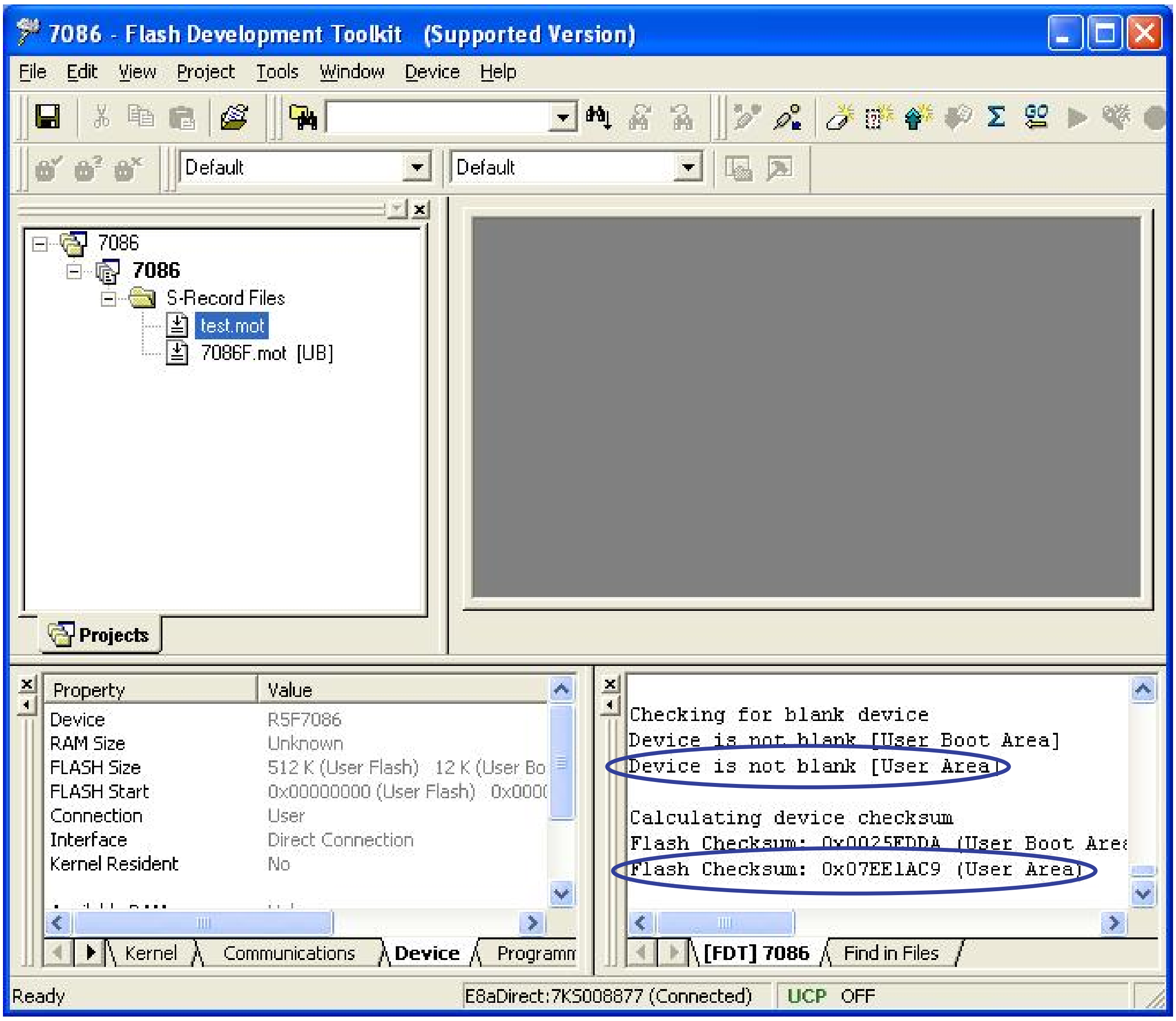
The program has been downloaded into the user area.



Property	Value
Device	R5F7086
RAM Size	Unknown
FLASH Size	512 K (User Flash) 12 K (User Bo
FLASH Start	0x00000000 (User Flash) 0x0000
Connection	User
Interface	Direct Connection
Kernel Resident	No

```
Writing image to device... [0x00000000 - (
Writing image to device... [0x00001000 - (
Data programmed at the following positions
 0x00000000 - 0x0000007F       Length : 0x(
 0x00001000 - 0x00001FFF       Length : 0x(
4.13 K programmed in 2 seconds
Image successfully written to device
```

(9) To verify that the program has been written to the user area, perform a blank check and a checksum.
Choose “Blank Check” from the Device menu.
Choose “Flash Checksum” from the Device menu.
The results of a blank check and a checksum will be displayed.



Property	Value
Device	R5F7086
RAM Size	Unknown
FLASH Size	512 K (User Flash) 12 K (User Bo
FLASH Start	0x00000000 (User Flash) 0x0000(
Connection	User
Interface	Direct Connection
Kernel Resident	No

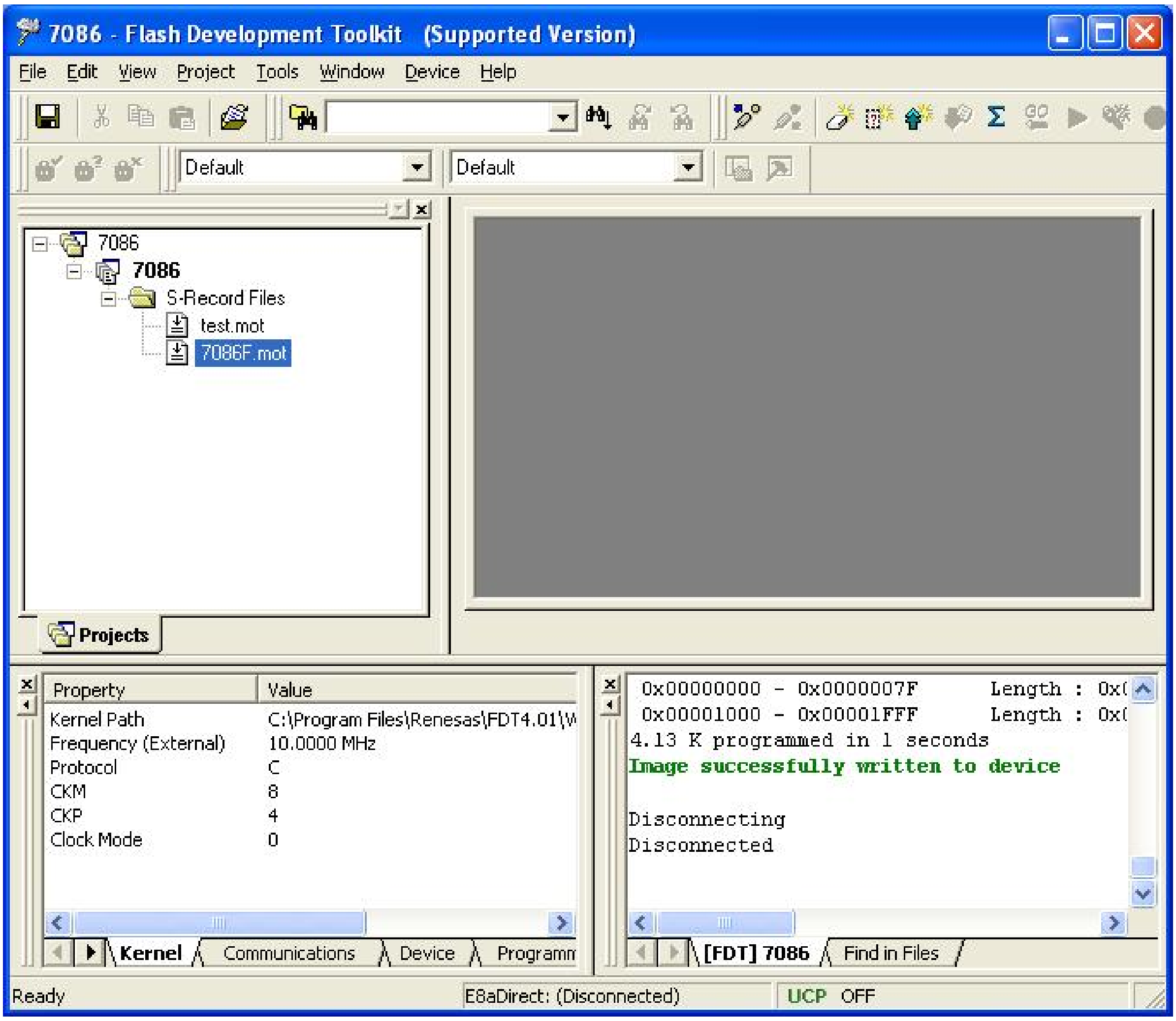
```
Checking for blank device
Device is not blank [User Boot Area]
Device is not blank [User Area]

Calculating device checksum
Flash Checksum: 0x0025FDDA (User Boot Are
Flash Checksum: 0x07EE1AC9 (User Area)
```

The result shows that the program has been written to the user area.

3.6 User Program Mode

In user program mode, it is possible to write to and erase the user area. Here, write the test.mot file to the user area the same way as in Section 3.5, “User Boot Mode.” This mode does not allow writing to and erasing the user boot area. Therefore, it is necessary that the load module file for user program mode be written in the user area beforehand.

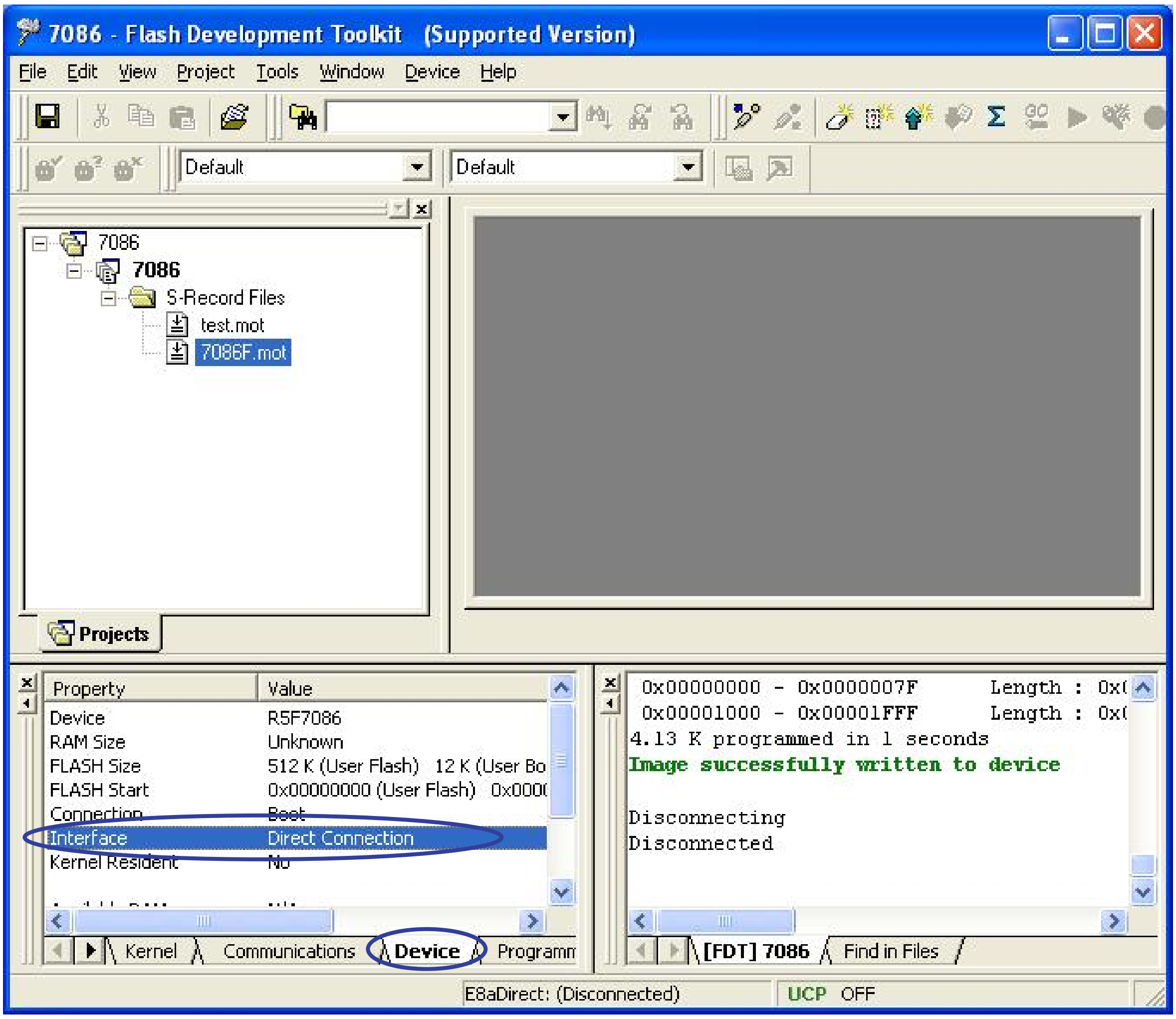
(1) Launch Flash Development Toolkit 4.01, open the project workspace file “7086.AWS,” and write the 7086F.mot file to the user area in boot mode.
After writing to the user area, disconnect the device and then choose “Project Setting” from the Device menu to display the project setting window.



Property	Value
Kernel Path	C:\Program Files\Renesas\FDT4.01\W
Frequency (External)	10.0000 MHz
Protocol	C
CKM	8
CKP	4
Clock Mode	0

```
 0x00000000 - 0x0000007F      Length : 0x(
 0x00001000 - 0x00001FFF      Length : 0x(
4.13 K programmed in 1 seconds
Image successfully written to device

Disconnecting
Disconnected
```

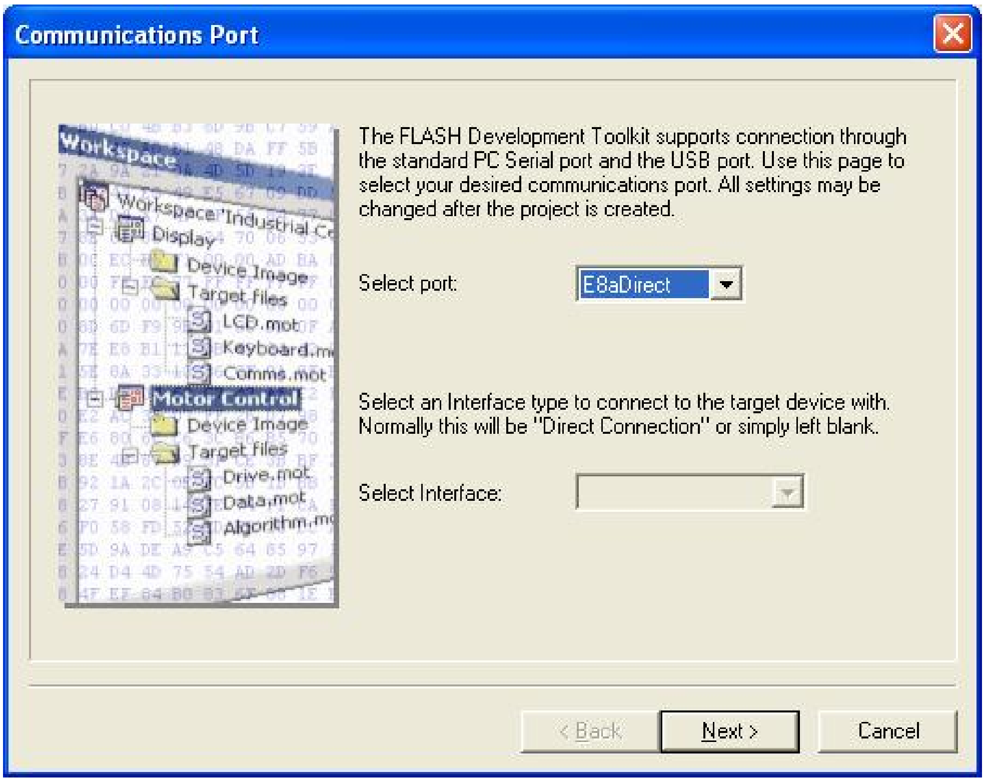
(2) Set up the user program mode.
Select the Device tab of the project setup window and double-click the “Interface Direct Connection” line.



Property	Value
Device	R5F7086
RAM Size	Unknown
FLASH Size	512 K (User Flash) 12 K (User Bo
FLASH Start	0x00000000 (User Flash) 0x0000
Connection	Boot
Interface	Direct Connection
Kernel Resident	No

```
 0x00000000 - 0x0000007F      Length : 0x(
 0x00001000 - 0x00001FFF      Length : 0x(
4.13 K programmed in 1 seconds
Image successfully written to device

Disconnecting
Disconnected
```

Click Next.



Communications Port

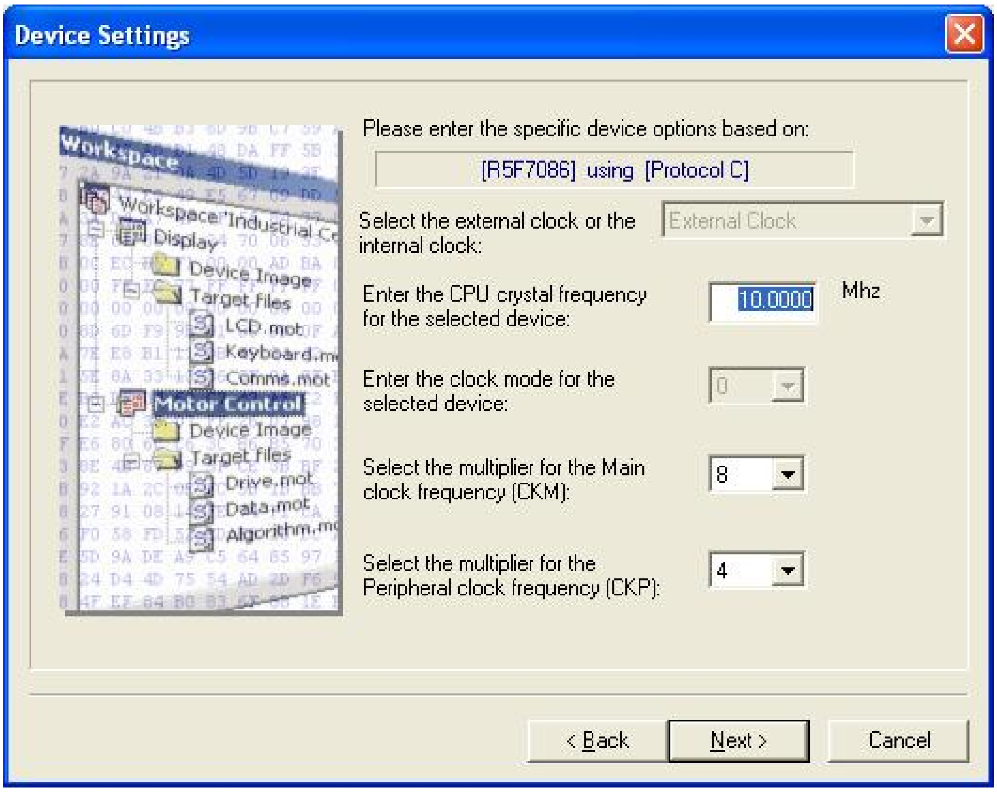
The FLASH Development Toolkit supports connection through the standard PC Serial port and the USB port. Use this page to select your desired communications port. All settings may be changed after the project is created.

Select port: E8aDirect

Select an Interface type to connect to the target device with. Normally this will be "Direct Connection" or simply left blank.

Select Interface:

Click Next.



Device Settings

Please enter the specific device options based on:

[R5F7086] using [Protocol C]

Select the external clock or the internal clock: External Clock

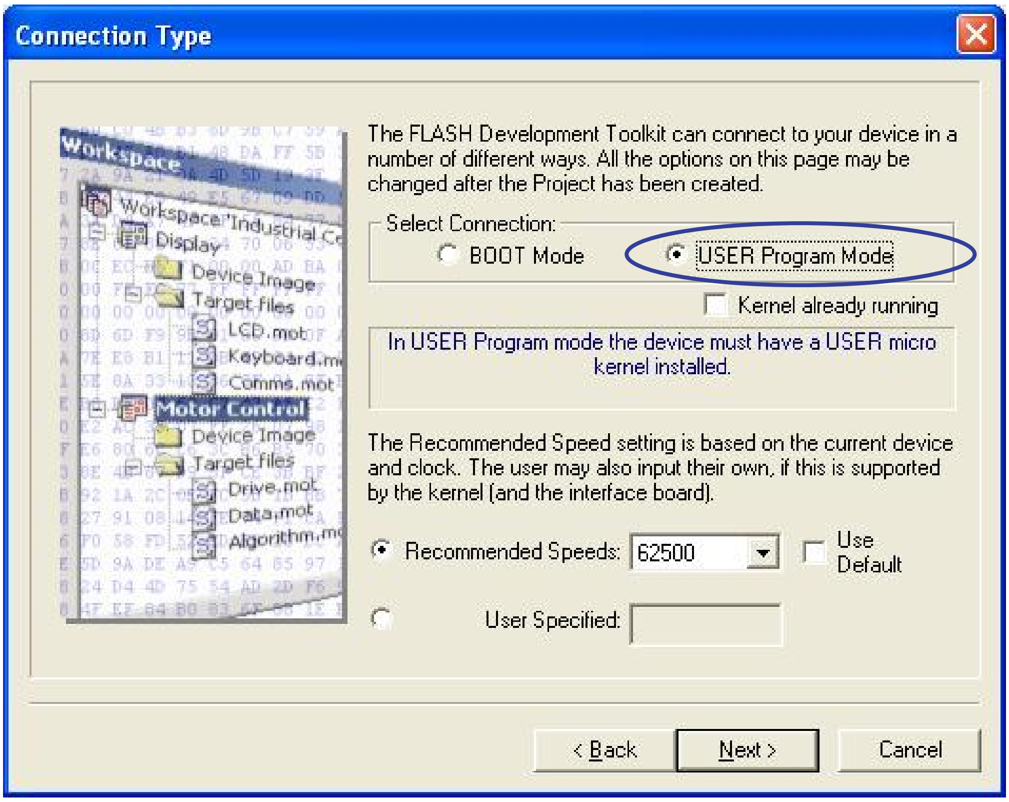
Enter the CPU crystal frequency for the selected device: 10.0000 Mhz

Enter the clock mode for the selected device: 0

Select the multiplier for the Main clock frequency (CKM): 8

Select the multiplier for the Peripheral clock frequency (CKP): 4

In the Select Connection column, select “USER Program Mode” and then click Next.



Connection Type

The FLASH Development Toolkit can connect to your device in a number of different ways. All the options on this page may be changed after the Project has been created.

Select Connection:

○ BOOT Mode ● USER Program Mode

□ Kernel already running

In USER Program mode the device must have a USER micro kernel installed.

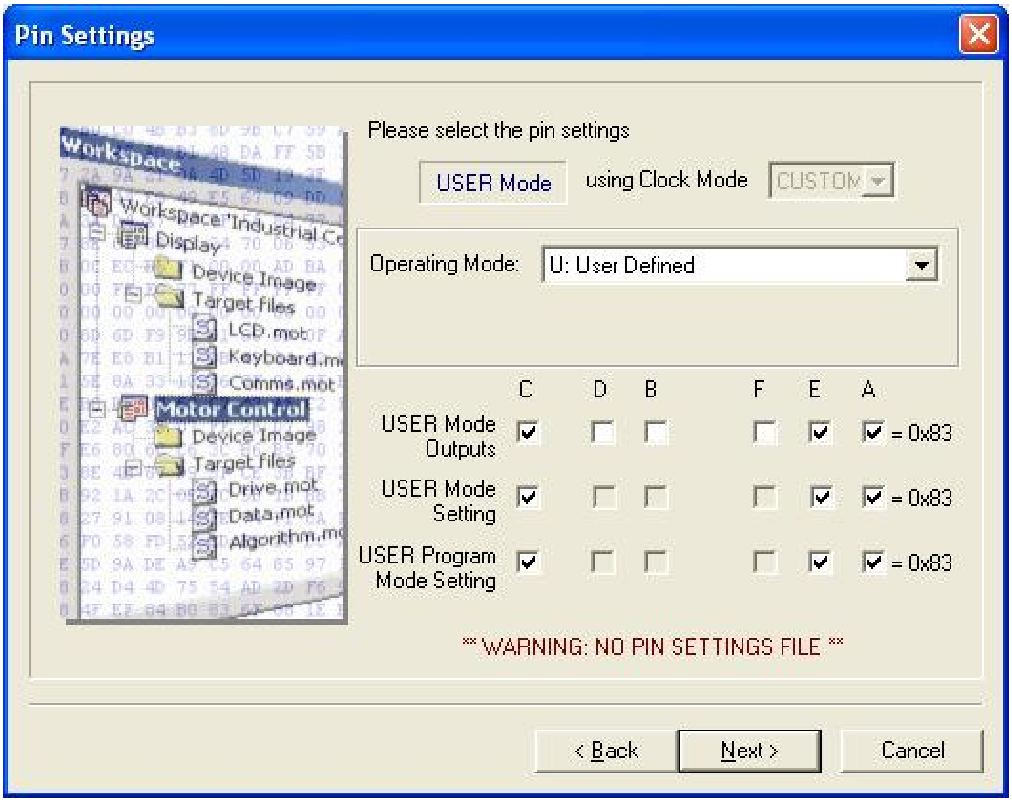
The Recommended Speed setting is based on the current device and clock. The user may also input their own, if this is supported by the kernel (and the interface board).

● Recommended Speeds: 62500 □ Use Default

○ User Specified:

Set up the E8a pins for user program mode.
Here, set for mode 7.
Set pin C (FWE), pin E (MD1) and pin A (MD0) to 1, and then click OK.

	Pin Setting			
Mode No.	FWE	MD1	MD0	Mode Name
Mode 6	1	1	0	User programming mode
Mode 7	1	1	1	



Pin Settings

Please select the pin settings

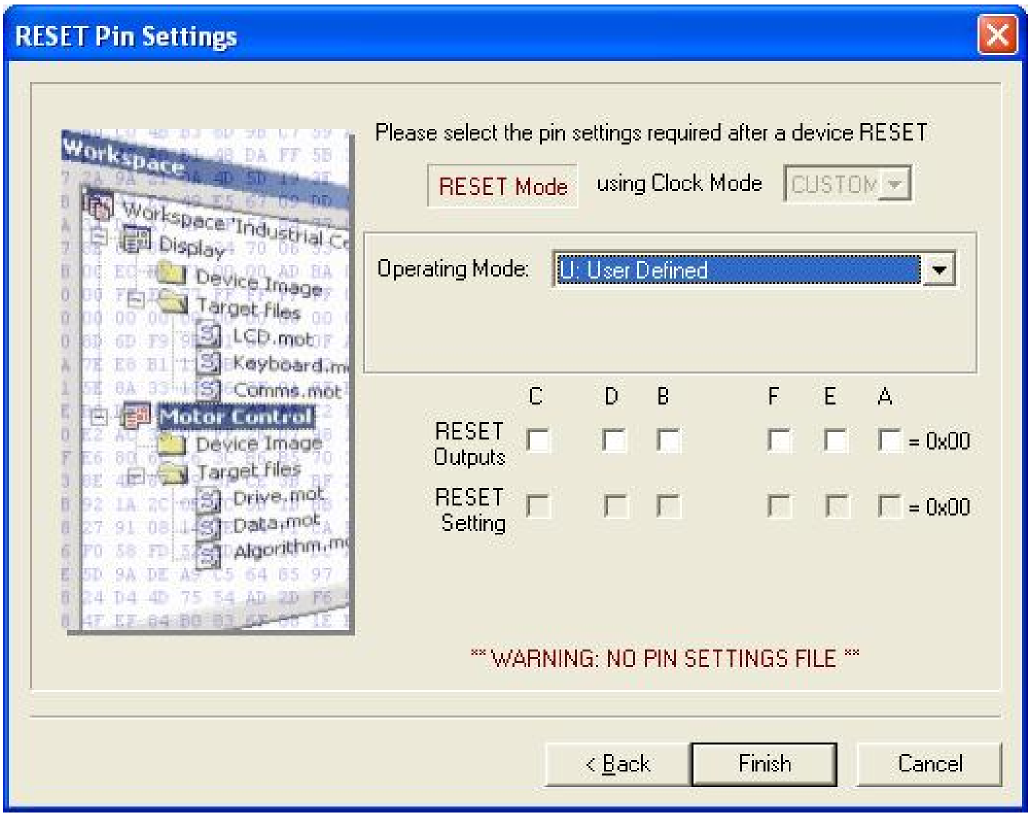
USER Mode using Clock Mode CUSTOM

Operating Mode: U: User Defined

	C	D	B	F	E	A	
USER Mode Outputs	☑	□	□	□	☑	☑	= 0x83
USER Mode Setting	☑	□	□	□	☑	☑	= 0x83
USER Program Mode Setting	☑	□	□	□	☑	☑	= 0x83

** WARNING: NO PIN SETTINGS FILE **

Click the Finish button.



RESET Pin Settings

Please select the pin settings required after a device RESET

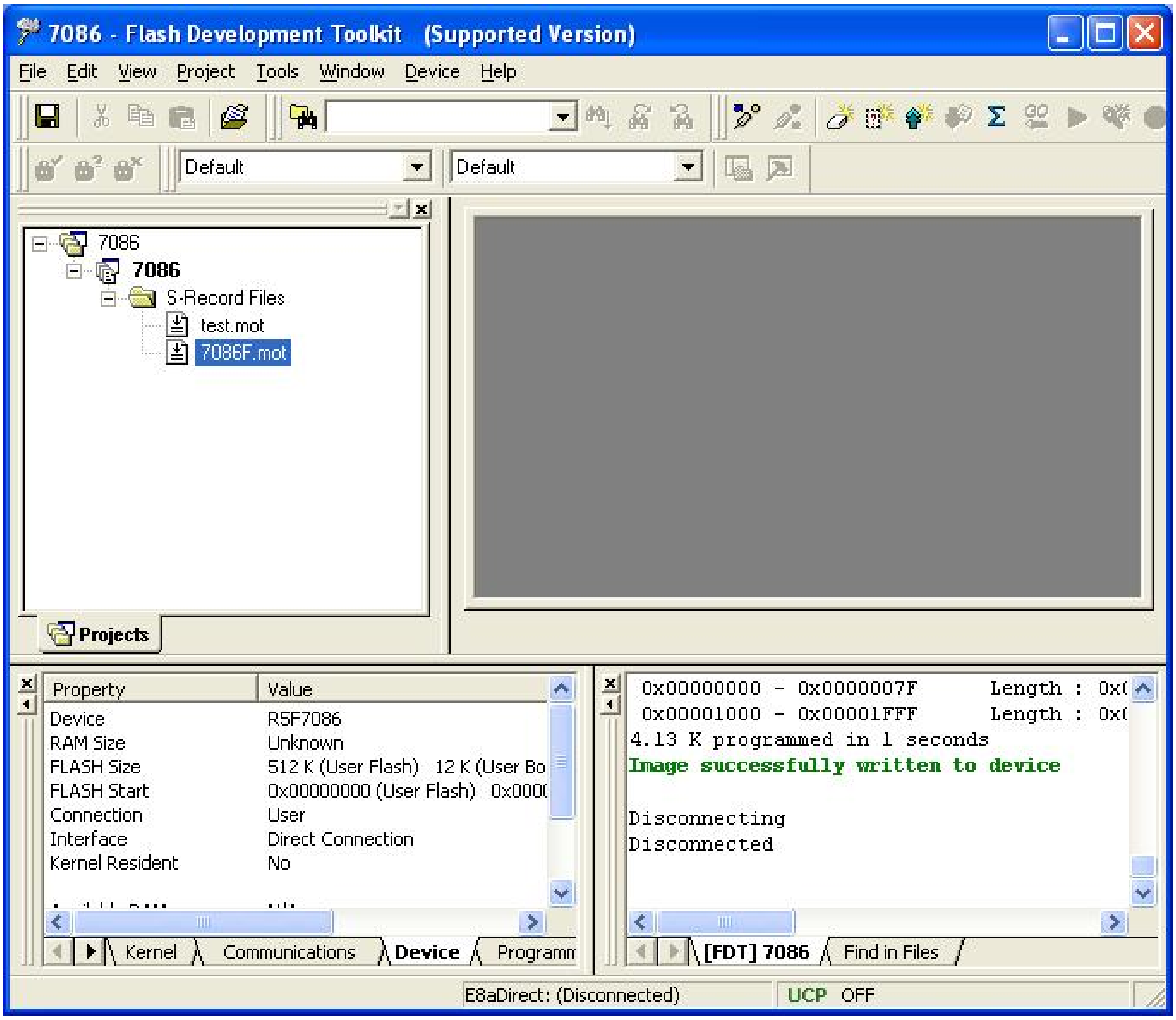
RESET Mode using Clock Mode CUSTOM

Operating Mode: U: User Defined

	C	D	B	F	E	A	
RESET Outputs	□	□	□	□	□	□	= 0x00
RESET Setting	□	□	□	□	□	□	= 0x00

** WARNING: NO PIN SETTINGS FILE **

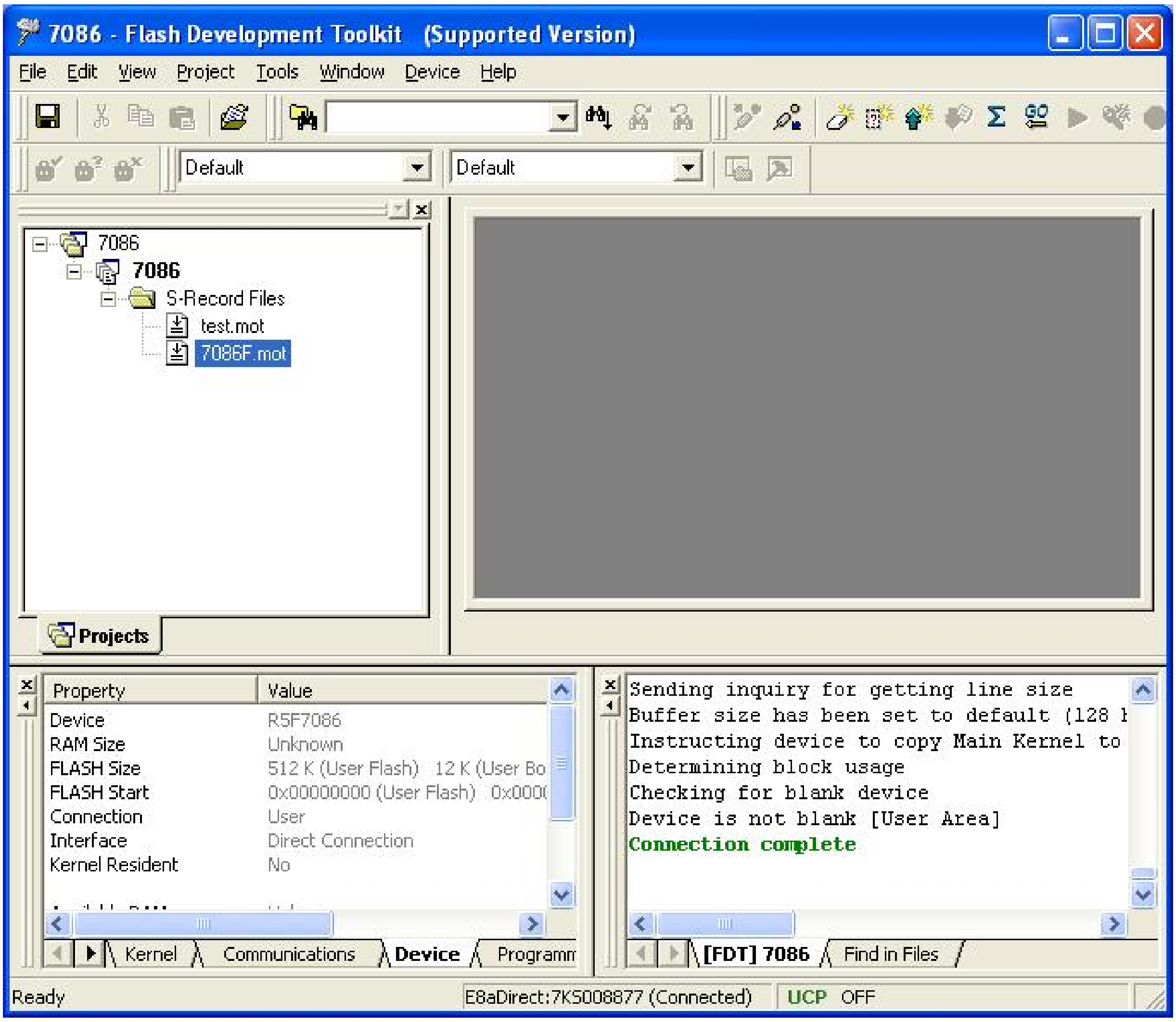
The user program mode has been set up.



Property	Value
Device	R5F7086
RAM Size	Unknown
FLASH Size	512 K (User Flash) 12 K (User Bo
FLASH Start	0x00000000 (User Flash) 0x0000(
Connection	User
Interface	Direct Connection
Kernel Resident	No

```
 0x00000000 - 0x0000007F      Length : 0x(
 0x00001000 - 0x00001FFF      Length : 0x(
4.13 K programmed in 1 seconds
Image successfully written to device

Disconnecting
Disconnected
```

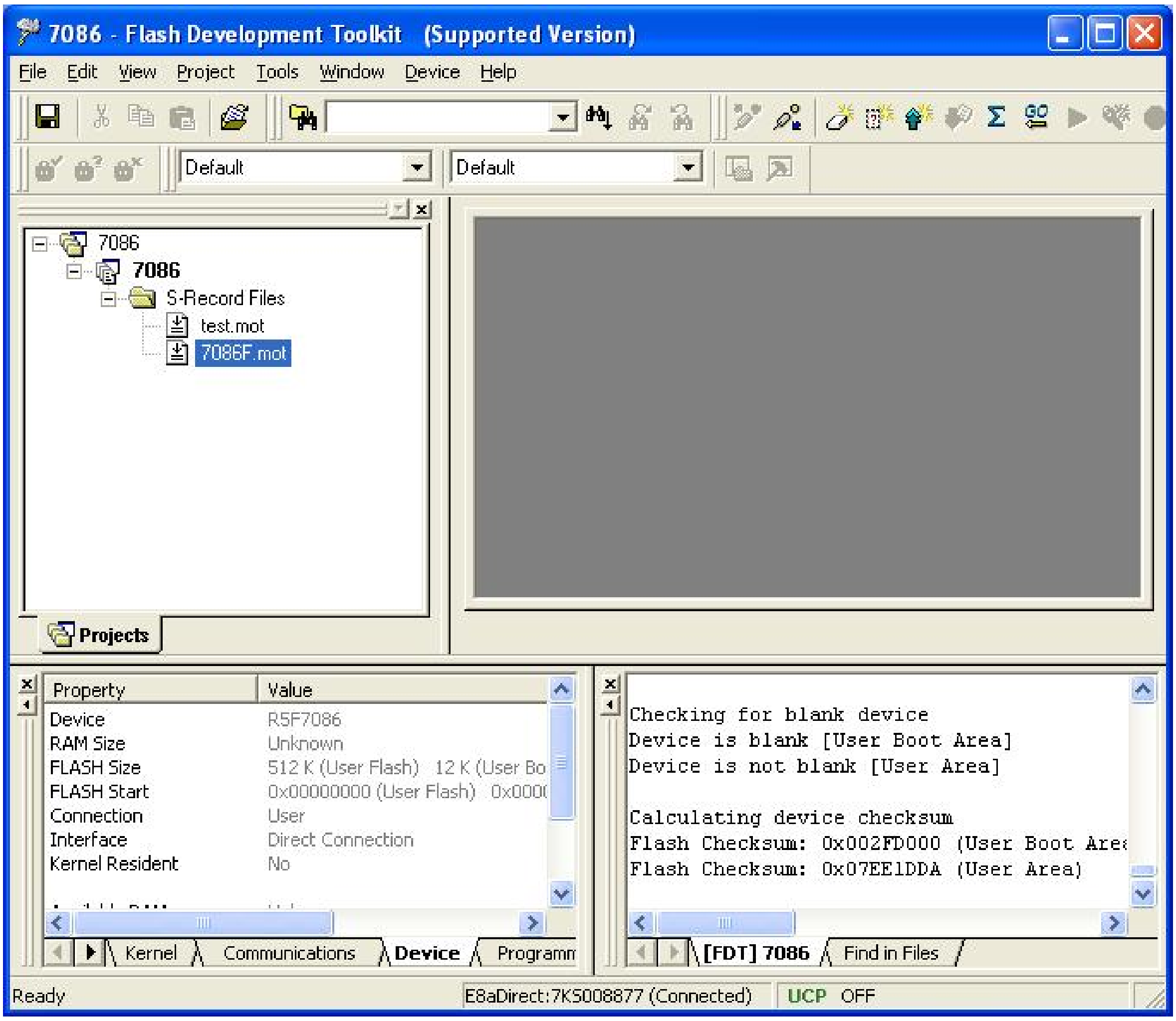
(3) Choose “Connect to Device” from the Device menu to connect the device.


7086 - Flash Development Toolkit (Supported Version)
File Edit View Project Tools Window Device Help
Default
Default
7086
7086
S-Record Files
test.mot
7086F.mot
Projects
Kernel
Communications
Device
Programm
[FDT] 7086
Find in Files
Ready
E8aDirect:7KS008877 (Connected)
UCP OFF

Property	Value
Device	R5F7086
RAM Size	Unknown
FLASH Size	512 K (User Flash) 12 K (User Bo
FLASH Start	0x00000000 (User Flash) 0x000(
Connection	User
Interface	Direct Connection
Kernel Resident	No

```
Sending inquiry for getting line size
Buffer size has been set to default (128 b
Instructing device to copy Main Kernel to
Determining block usage
Checking for blank device
Device is not blank [User Area]
Connection complete
```

(4) Before writing the test_mot file to the user area, perform a blank check and a checksum.
Choose “Blank Check” from the Device menu.
Choose “Flash Checksum” from the Device menu.
The results of a blank check and a checksum will be displayed.

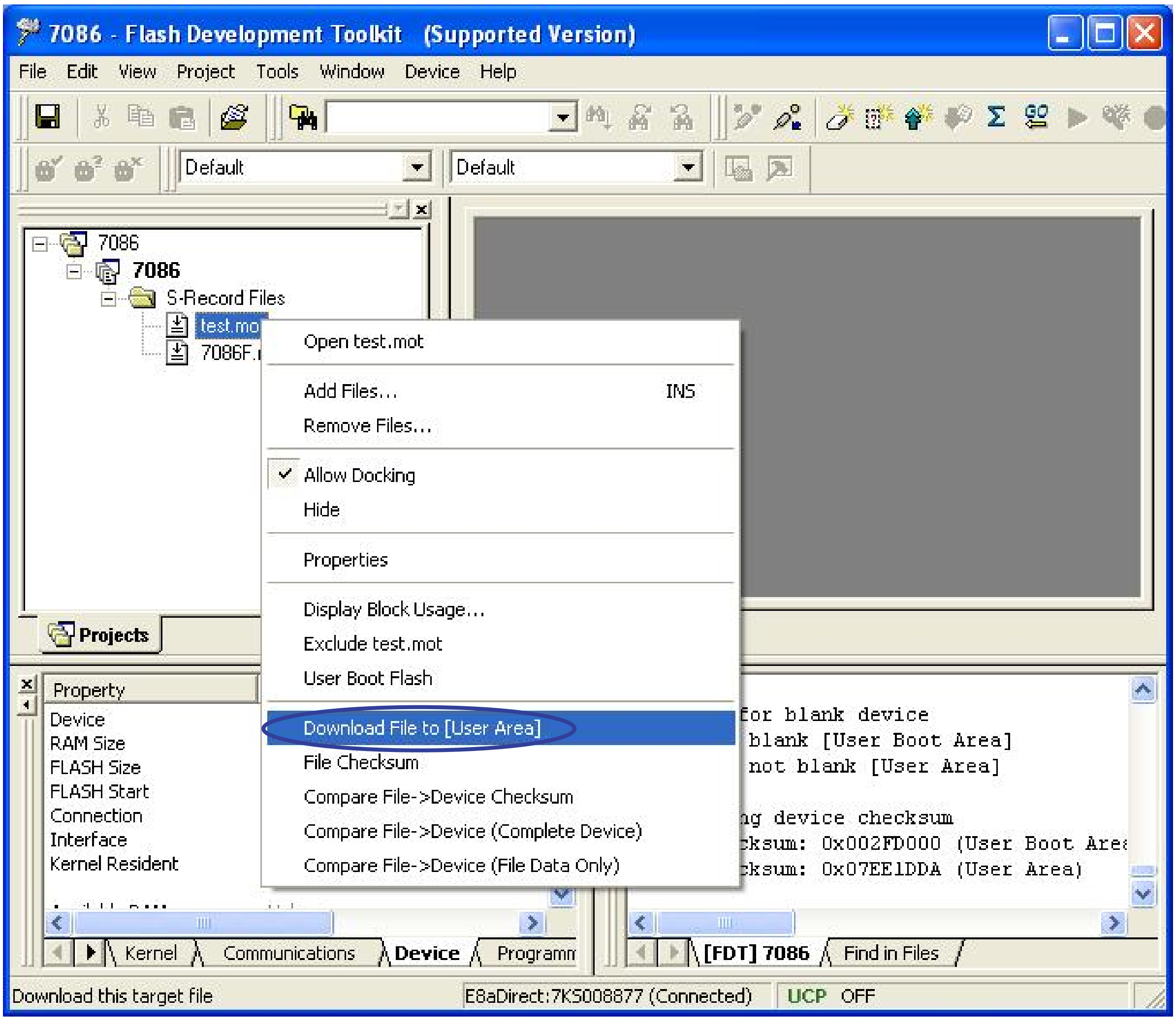


Property	Value
Device	R5F7086
RAM Size	Unknown
FLASH Size	512 K (User Flash) 12 K (User Bo
FLASH Start	0x00000000 (User Flash) 0x0000(
Connection	User
Interface	Direct Connection
Kernel Resident	No

```
Checking for blank device
Device is blank [User Boot Area]
Device is not blank [User Area]

Calculating device checksum
Flash Checksum: 0x002FD000 (User Boot Area
Flash Checksum: 0x07EE1DDA (User Area)
```

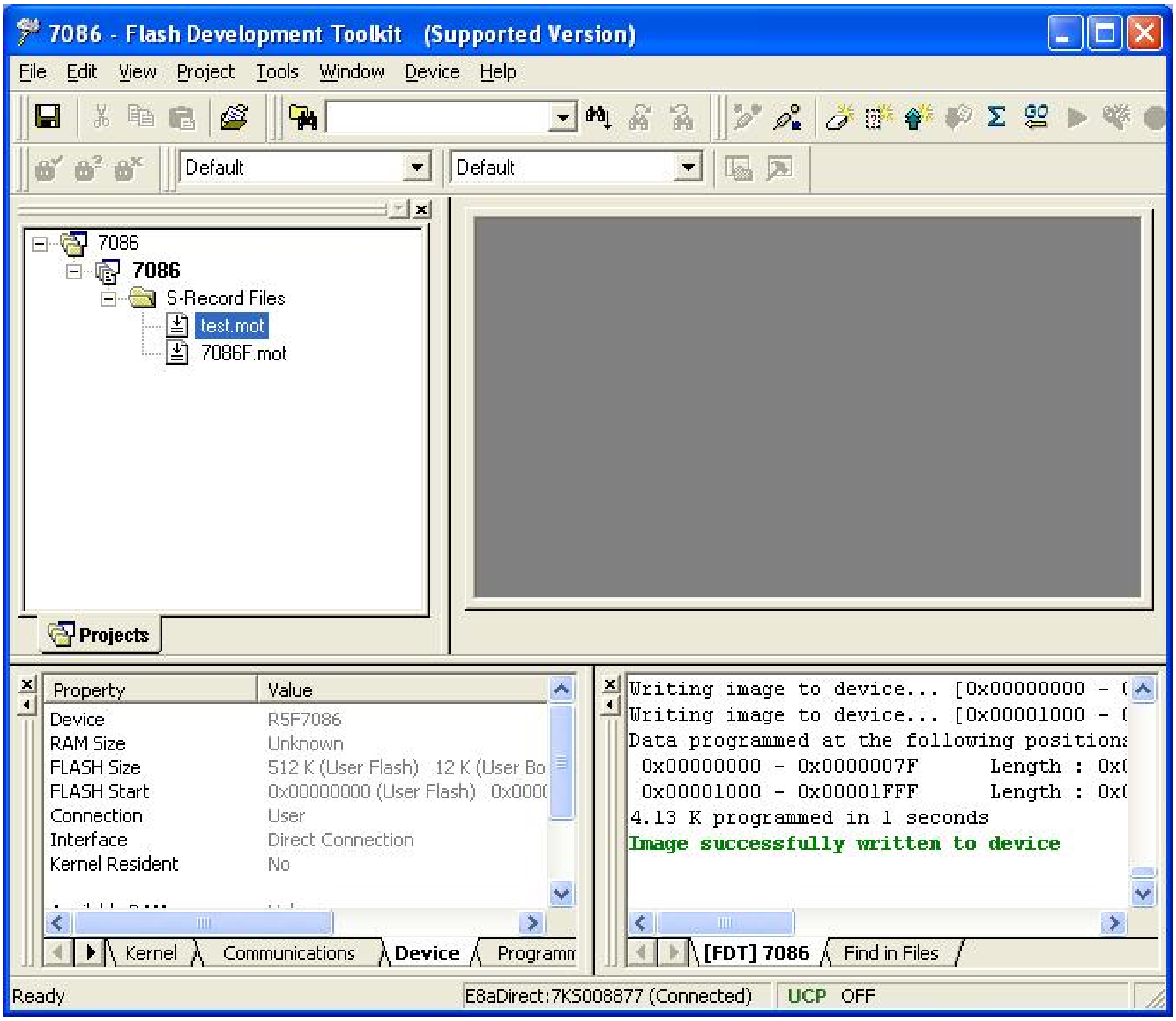
Ready   E8aDirect:7KS008877 (Connected)   UCP OFF

(5) Write to the user area in user program mode.
Right-click the test_mot file, and from the popup menu choose “Download [User Area]” to download the test_mot file into the user area.



```
for blank device
 blank [User Boot Area]
 not blank [User Area]

ng device checksum
cksum: 0x002FD000 (User Boot Are
cksum: 0x07EE1DDA (User Area)
```

The program has been downloaded into the user area.

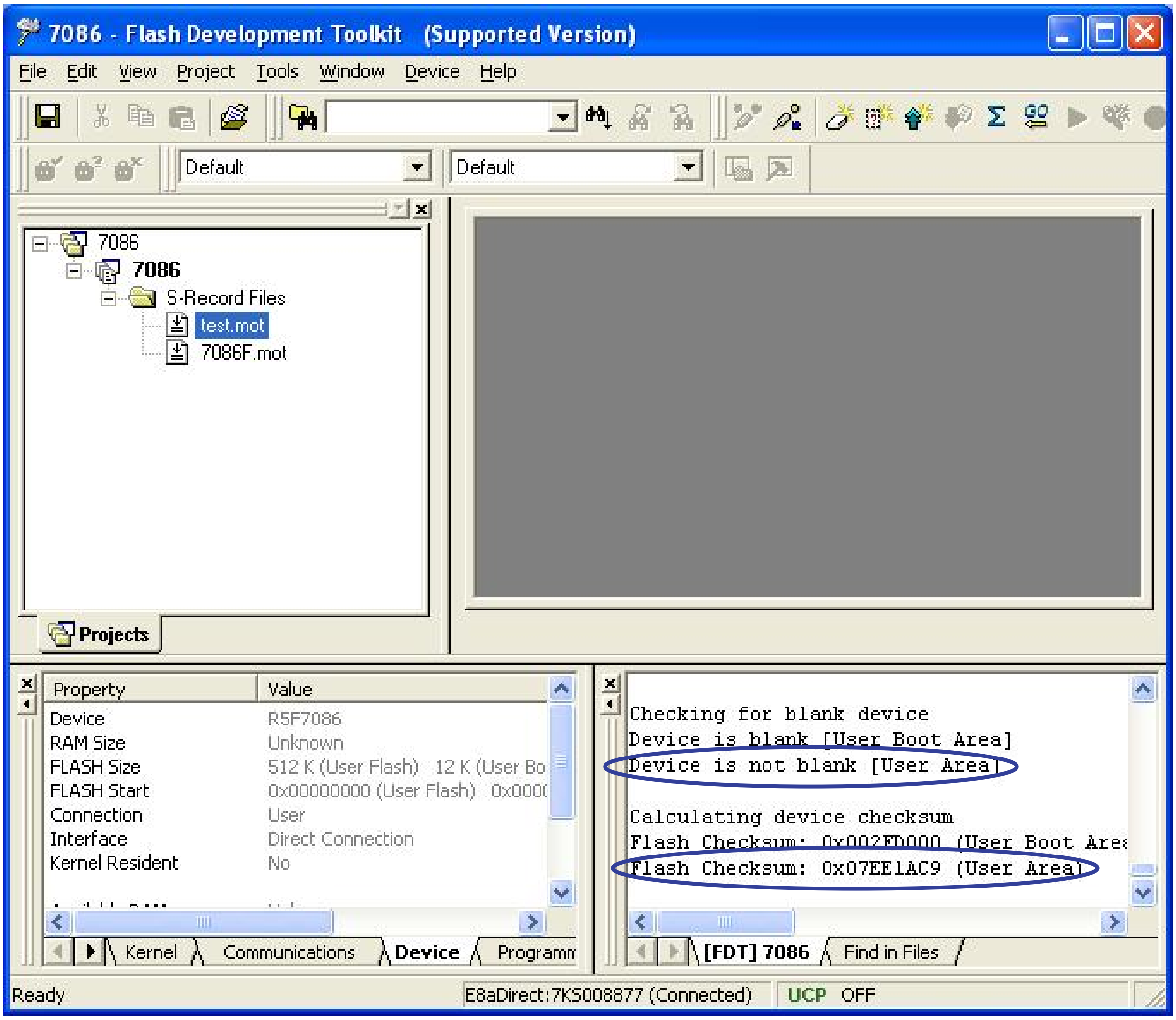


Property	Value
Device	R5F7086
RAM Size	Unknown
FLASH Size	512 K (User Flash) 12 K (User Bo
FLASH Start	0x00000000 (User Flash) 0x000(
Connection	User
Interface	Direct Connection
Kernel Resident	No

```
Writing image to device... [0x00000000 - (
Writing image to device... [0x00001000 - (
Data programmed at the following positions
 0x00000000 - 0x0000007F      Length : 0x(
 0x00001000 - 0x00001FFF      Length : 0x(
4.13 K programmed in 1 seconds
Image successfully written to device
```

Ready   E8aDirect:7KS008877 (Connected)   UCP OFF

(6) To verify that the program has been written to the user area, perform a blank check and a checksum.
Choose “Blank Check” from the Device menu.
Choose “Flash Checksum” from the Device menu.
The results of a blank check and a checksum will be displayed.


7086 - Flash Development Toolkit (Supported Version)
File Edit View Project Tools Window Device Help
Default
Default
7086
7086
S-Record Files
test.mot
7086F.mot
Projects
Kernel
Communications
Device
Programm
[FDT] 7086
Find in Files
Ready
E8aDirect:7KS008877 (Connected)
UCP OFF

Property	Value
Device	R5F7086
RAM Size	Unknown
FLASH Size	512 K (User Flash) 12 K (User Bo
FLASH Start	0x00000000 (User Flash) 0x0000
Connection	User
Interface	Direct Connection
Kernel Resident	No

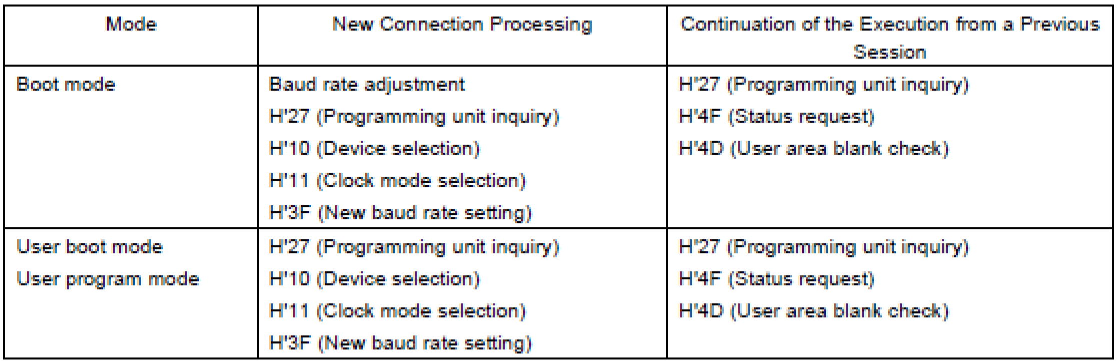
```
Checking for blank device
Device is blank [User Boot Area]
Device is not blank [User Area]

Calculating device checksum
Flash Checksum: 0x002FD000 (User Boot Are
Flash Checksum: 0x07EE1AC9 (User Area)
```

The result shows that the program has been written to the user area.

4. Processes of the Flash Development Toolkit

The Flash Development Toolkit has three modes in which it connects to the device: Boot mode, user boot mode and user program mode. In each mode, it is possible to specify a continuance of execution from the preceding session. Normally, use a new connection process.

The codes expressed in hexadecimal are the command codes of the Flash Development Toolkit. For details, see Section 2.3, “Flash Memory,” of the hardware manual.



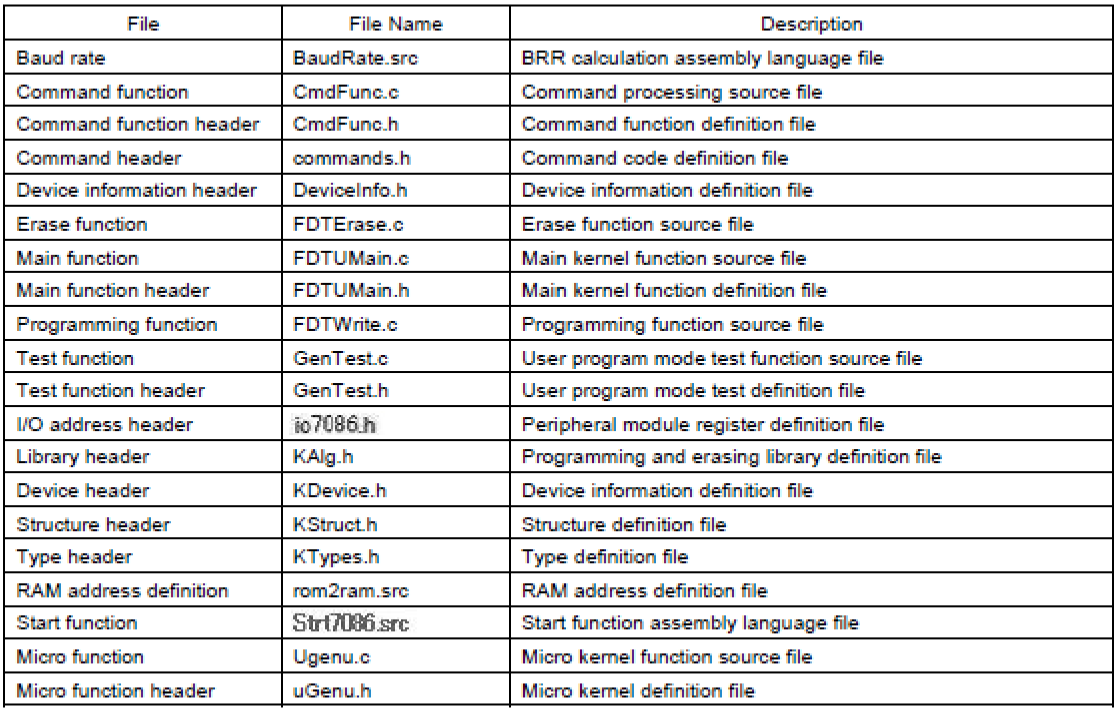
Mode	New Connection Processing	Continuation of the Execution from a Previous Session
Boot mode	Baud rate adjustment H'27 (Programming unit inquiry) H'10 (Device selection) H'11 (Clock mode selection) H'3F (New baud rate setting)	H'27 (Programming unit inquiry) H'4F (Status request) H'4D (User area blank check)
User boot mode User program mode	H'27 (Programming unit inquiry) H'10 (Device selection) H'11 (Clock mode selection) H'3F (New baud rate setting)	H'27 (Programming unit inquiry) H'4F (Status request) H'4D (User area blank check)

5. Files for User Program Mode

This section describes the files for user program mode.

5.1 Source File List

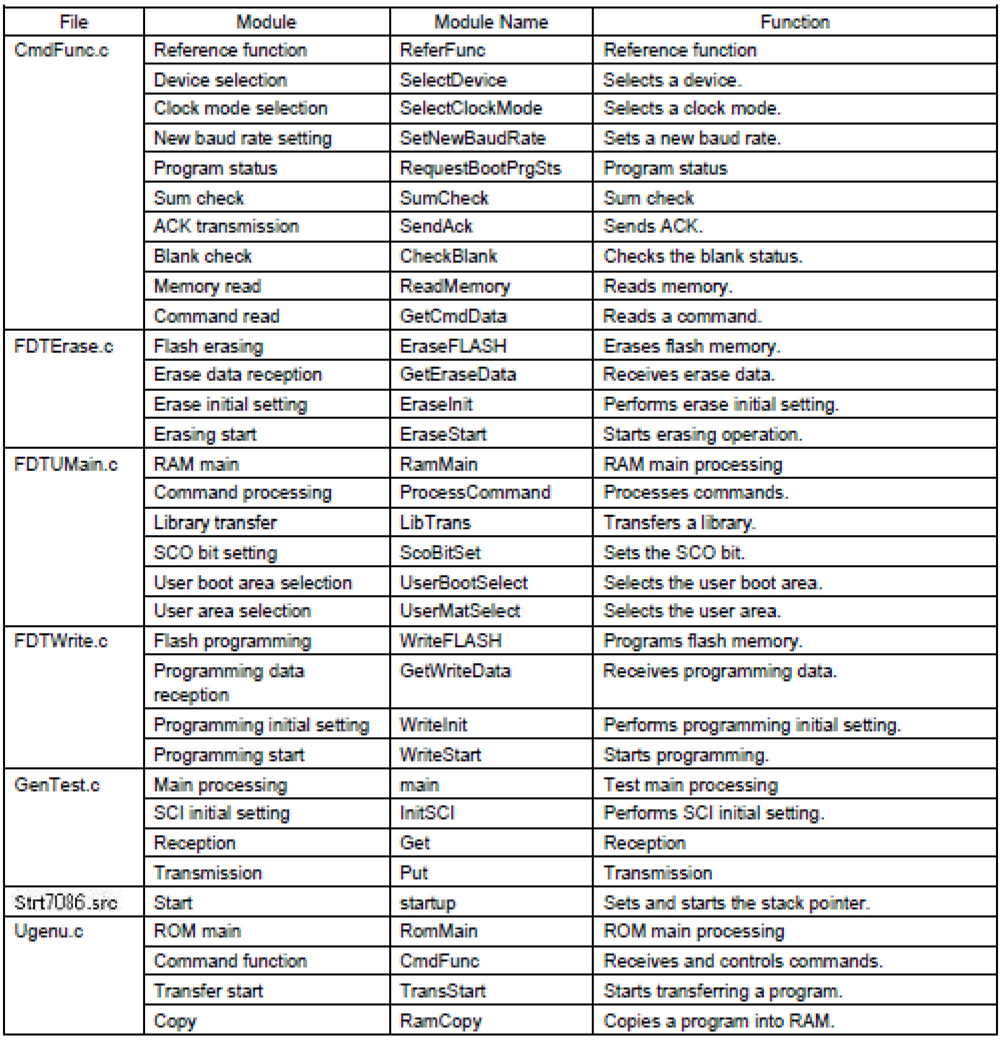
The source files are listed below.



File	File Name	Description
Baud rate	BaudRate.src	BRR calculation assembly language file
Command function	CmdFunc.c	Command processing source file
Command function header	CmdFunc.h	Command function definition file
Command header	commands.h	Command code definition file
Device information header	DeviceInfo.h	Device information definition file
Erase function	FDTErase.c	Erase function source file
Main function	FDTUMain.c	Main kernel function source file
Main function header	FDTUMain.h	Main kernel function definition file
Programming function	FDTWrite.c	Programming function source file
Test function	GenTest.c	User program mode test function source file
Test function header	GenTest.h	User program mode test definition file
I/O address header	io7086.h	Peripheral module register definition file
Library header	KAlg.h	Programming and erasing library definition file
Device header	KDevice.h	Device information definition file
Structure header	KStruct.h	Structure definition file
Type header	KTypes.h	Type definition file
RAM address definition	rom2ram.src	RAM address definition file
Start function	Strt7086.src	Start function assembly language file
Micro function	Ugenu.c	Micro kernel function source file
Micro function header	uGenu.h	Micro kernel definition file

5.2 Module List

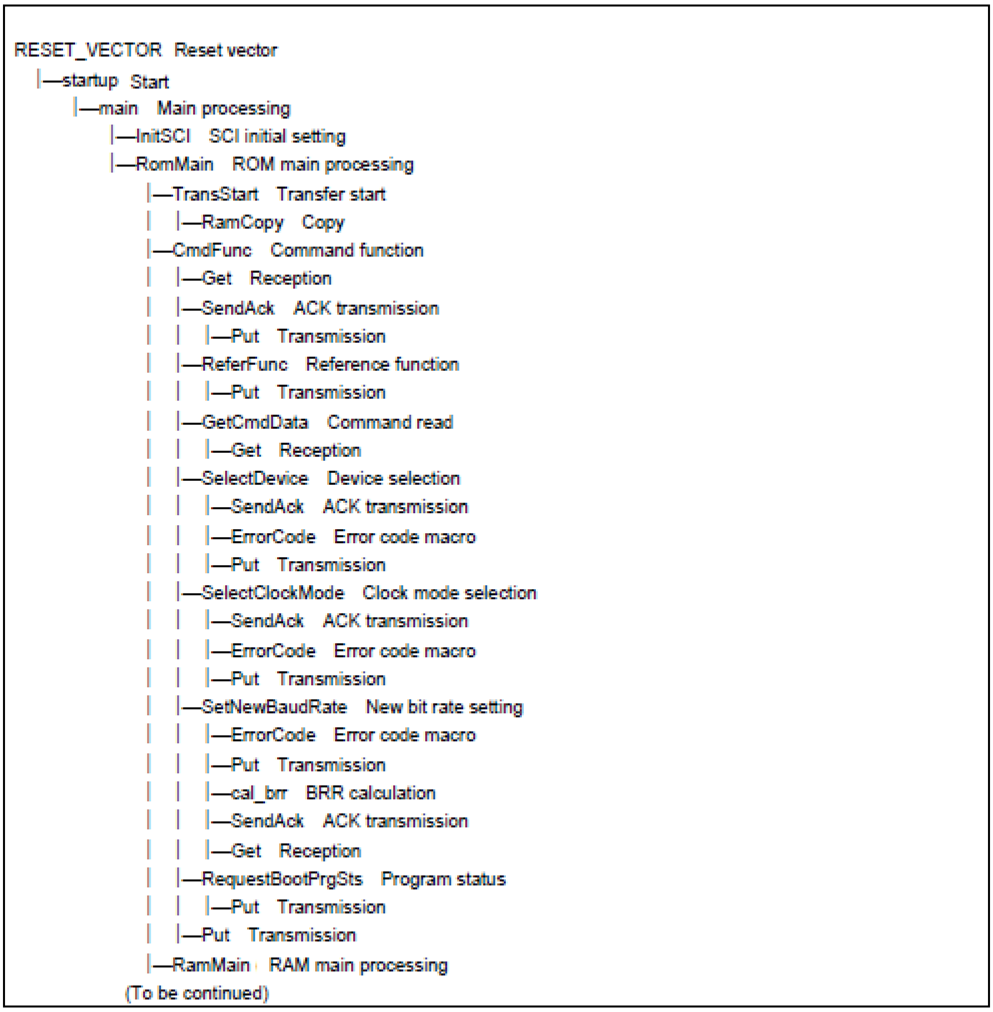
The modules are listed below.



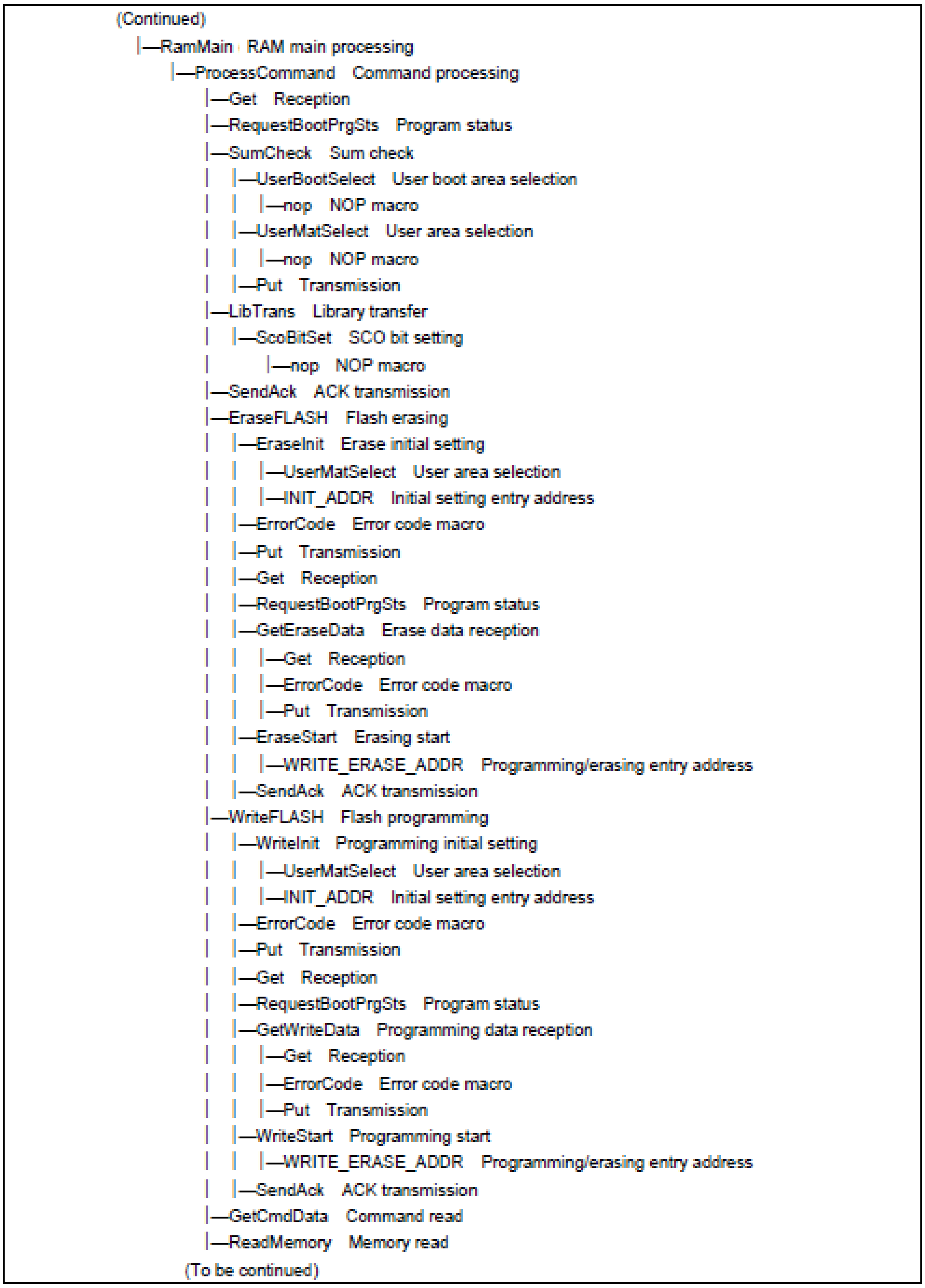
File	Module	Module Name	Function
CmdFunc.c	Reference function	ReferFunc	Reference function
	Device selection	SelectDevice	Selects a device.
	Clock mode selection	SelectClockMode	Selects a clock mode.
	New baud rate setting	SetNewBaudRate	Sets a new baud rate.
	Program status	RequestBootPrgSts	Program status
	Sum check	SumCheck	Sum check
	ACK transmission	SendAck	Sends ACK.
	Blank check	CheckBlank	Checks the blank status.
	Memory read	ReadMemory	Reads memory.
	Command read	GetCmdData	Reads a command.
FDTErase.c	Flash erasing	EraseFLASH	Erases flash memory.
	Erase data reception	GetEraseData	Receives erase data.
	Erase initial setting	EraseInit	Performs erase initial setting.
	Erasing start	EraseStart	Starts erasing operation.
FDTUMain.c	RAM main	RamMain	RAM main processing
	Command processing	ProcessCommand	Processes commands.
	Library transfer	LibTrans	Transfers a library.
	SCO bit setting	ScoBitSet	Sets the SCO bit.
	User boot area selection	UserBootSelect	Selects the user boot area.
	User area selection	UserMatSelect	Selects the user area.
FDTWrite.c	Flash programming	WriteFLASH	Programs flash memory.
	Programming data reception	GetWriteData	Receives programming data.
	Programming initial setting	WriteInit	Performs programming initial setting.
	Programming start	WriteStart	Starts programming.
GenTest.c	Main processing	main	Test main processing
	SCI initial setting	InitSCI	Performs SCI initial setting.
	Reception	Get	Reception
	Transmission	Put	Transmission
Strt7086.src	Start	startup	Sets and starts the stack pointer.
Ugenu.c	ROM main	RomMain	ROM main processing
	Command function	CmdFunc	Receives and controls commands.
	Transfer start	TransStart	Starts transferring a program.
	Copy	RamCopy	Copies a program into RAM.

5.3 Hierarchical Module Structure

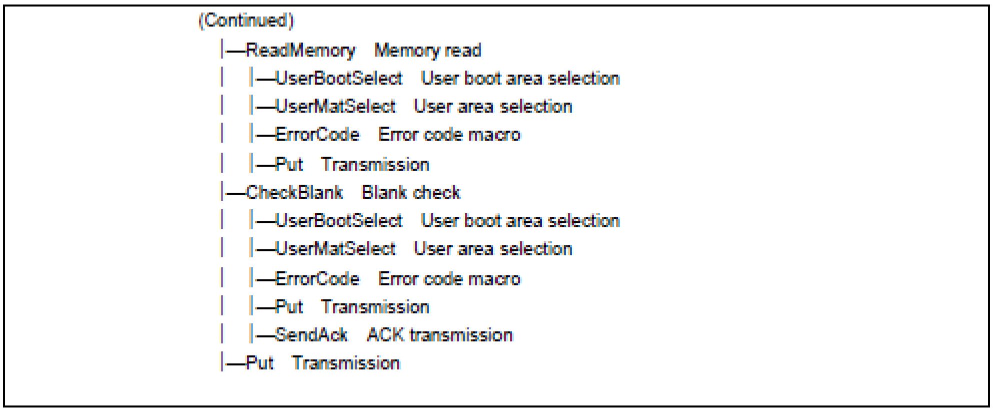
The hierarchical structure of the modules is shown below.



```
RESET_VECTOR  Reset vector
  |—startup  Start
     |—main   Main processing
        |—InitSCI   SCI initial setting
        |—RomMain   ROM main processing
           |—TransStart   Transfer start
           |   |—RamCopy   Copy
           |—CmdFunc   Command function
           |   |—Get   Reception
           |   |—SendAck   ACK transmission
           |   |   |—Put   Transmission
           |   |—ReferFunc   Reference function
           |   |   |—Put   Transmission
           |   |—GetCmdData   Command read
           |   |   |—Get   Reception
           |   |—SelectDevice   Device selection
           |   |   |—SendAck   ACK transmission
           |   |   |—ErrorCode   Error code macro
           |   |   |—Put   Transmission
           |   |—SelectClockMode   Clock mode selection
           |   |   |—SendAck   ACK transmission
           |   |   |—ErrorCode   Error code macro
           |   |   |—Put   Transmission
           |   |—SetNewBaudRate   New bit rate setting
           |   |   |—ErrorCode   Error code macro
           |   |   |—Put   Transmission
           |   |   |—cal_brr   BRR calculation
           |   |   |—SendAck   ACK transmission
           |   |   |—Get   Reception
           |   |—RequestBootPrgSts   Program status
           |   |   |—Put   Transmission
           |   |—Put   Transmission
           |—RamMain   RAM main processing
        (To be continued)
```



```
(Continued)
  |—RamMain  RAM main processing
     |—ProcessCommand   Command processing
        |—Get   Reception
        |—RequestBootPrgSts   Program status
        |—SumCheck   Sum check
        |   |—UserBootSelect   User boot area selection
        |   |   |—nop   NOP macro
        |   |—UserMatSelect   User area selection
        |   |   |—nop   NOP macro
        |   |—Put   Transmission
        |—LibTrans   Library transfer
        |   |—ScoBitSet   SCO bit setting
        |        |—nop   NOP macro
        |—SendAck   ACK transmission
        |—EraseFLASH   Flash erasing
        |   |—EraseInit   Erase initial setting
        |   |   |—UserMatSelect   User area selection
        |   |   |—INIT_ADDR   Initial setting entry address
        |   |—ErrorCode   Error code macro
        |   |—Put   Transmission
        |   |—Get   Reception
        |   |—RequestBootPrgSts   Program status
        |   |—GetEraseData   Erase data reception
        |   |   |—Get   Reception
        |   |   |—ErrorCode   Error code macro
        |   |   |—Put   Transmission
        |   |—EraseStart   Erasing start
        |   |   |—WRITE_ERASE_ADDR   Programming/erasing entry address
        |   |—SendAck   ACK transmission
        |—WriteFLASH   Flash programming
        |   |—WriteInit   Programming initial setting
        |   |   |—UserMatSelect   User area selection
        |   |   |—INIT_ADDR   Initial setting entry address
        |   |—ErrorCode   Error code macro
        |   |—Put   Transmission
        |   |—Get   Reception
        |   |—RequestBootPrgSts   Program status
        |   |—GetWriteData   Programming data reception
        |   |   |—Get   Reception
        |   |   |—ErrorCode   Error code macro
        |   |   |—Put   Transmission
        |   |—WriteStart   Programming start
        |   |   |—WRITE_ERASE_ADDR   Programming/erasing entry address
        |   |—SendAck   ACK transmission
        |—GetCmdData   Command read
        |—ReadMemory   Memory read
      (To be continued)
```



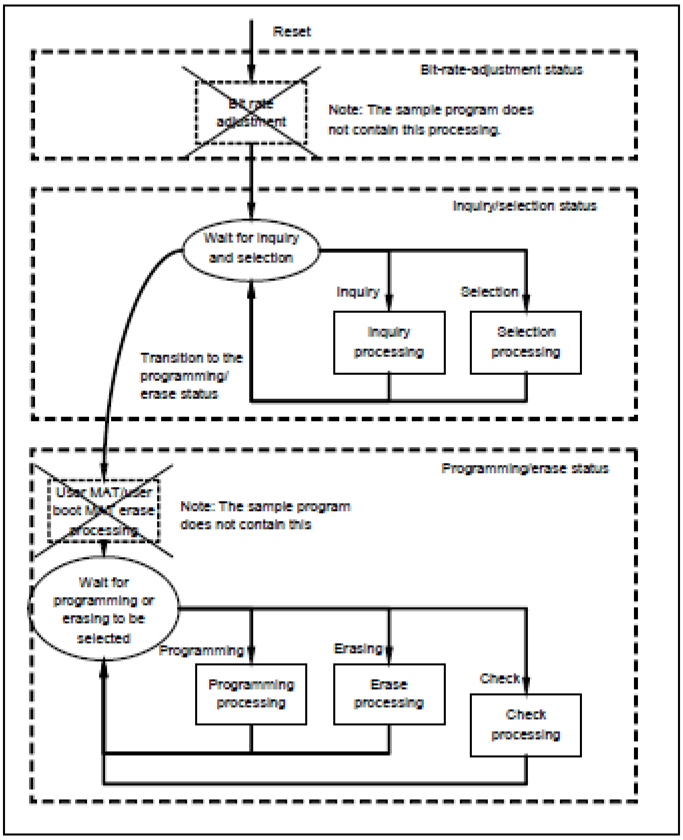
```
(Continued)
 |—ReadMemory    Memory read
 |    |—UserBootSelect    User boot area selection
 |    |—UserMatSelect    User area selection
 |    |—ErrorCode    Error code macro
 |    |—Put    Transmission
 |—CheckBlank    Blank check
 |    |—UserBootSelect    User boot area selection
 |    |—UserMatSelect    User area selection
 |    |—ErrorCode    Error code macro
 |    |—Put    Transmission
 |    |—SendAck    ACK transmission
 |—Put    Transmission
```

5.4 Program Flow

This section describes a program flow referring to the hierarchical module structure.

(1) Program processing flow

The processing flow of the program is shown below. In user program mode, the bit rate synchronization and user area erase process normally executed in boot mode are not performed. Therefore, the program and data written into the flash memory can be saved.


Reset
Bit-rate-adjustment status
Bit rate adjustment
Note: The sample program does not contain this processing.
Inquiry/selection status
Wait for inquiry and selection
Inquiry
Selection
Inquiry processing
Selection processing
Transition to the programming/ erase status
Programming/erase status
User MAT/user boot MAT erase processing
Note: The sample program does not contain this
Wait for programming or erasing to be selected
Programming
Erasing
Check
Programming processing
Erase processing
Check processing

(2) Main process (main)

The flow of the main process is shown below.

1. Branch from the reset vector to start (startup).
2. Start (startup) sets the stack pointer and calls the main process (main).
3. The main process (main) calls SCI initialization (InitSCI) and branches to ROM main process (RomMain).
4. The ROM main process (RomMain) transfers RAM main process to the RAM and then accepts and processes commands and sets specification.
   When setting is complete, it branches to RAM main process (RamMain) in the RAM.
5. The RAM main process (RamMain) processes received commands to execute the processing listed below.
   Write/erase library transfer (LibTrans)
   Erase flash memory (EraseFLASH)
   Write to flash memory (WriteFLASH)
   User boot area/user area memory read (ReadMemory)
   User boot area/user area sum check (SumCheck)
   User boot area/user area blank check (CheckBlank)

[Note] The ROM main process (RomMain) is also referred to as the micro kernel. It operates in the ROM.
The RAM main process (RamMain) is also referred to as the main kernel. It operates in the RAM.

(3) ROM main process (RomMain)

The flow of the ROM main process (RomMain) is shown below.

1. In transfer start (TransStart), transfer a program from the ROM where it is stored to the RAM.
   This is to enable library transfers and write/erases to be processed in the RAM.
2. In command function (CmdFunc), process commands and set selection corresponding to inquiries.
3. Inquiries are handled in the reference function (ReferFunc) and program status (RequestBootPrgSts), with the following commands supported.
   Support device inquiry
   Clock mode inquiry
   Multiply factor inquiry
   Operating clock frequency inquiry
   User boot area information inquiry
   User area information inquiry
   Erase block information inquiry
   Write size inquiry
   Boot program status inquiry
4. Selection settings are made in the following modules.
   Device selection (SelectDevice): Selects device code
   Clock mode selection (SelectClockMode): Notifies selected clock mode
   New baud rate setting (SetNewBaudRate): Selects new baud rate
5. When inquiry selection is complete, branch to the RAM main process (RamMain) that was transferred to the RAM.

(4) RAM main process (RamMain)

The flow of the RAM main process (RamMain) is shown below.

1. In command process (ProcessCommand), process the commands. The processed commands are listed below.
   Since the files for user program mode are run in user programming mode, selecting a write to the user boot area and erasing blocks of the user boot area cannot be performed.
   User area write selection
   128 byte write
   Erase selection
   Block erase
   Memory read
   User boot area sum check
   User area sum check
   User boot area blank check
   User area blank check
   Boot program status inquiry
2. In the user area write select command, transfer a write library by library transfer (LibTrans) and then branch to flash write (WriteFLASH).
3. In flash write (WriteFLASH), set a clock frequency by write initialization (WriteInit).
   Next, read in a command and if it’s a 128 byte write, receive the write data by write data reception (GetWriteData) and write it to the flash memory by write start (EraseStart).
   If the 128-byte data is the one at the end of write address, set an end of write code in the data to write and at the address to which to write, and then terminate a write (actually by calling write start (EraseStart)) to complete the write process.
4. In the erase select command, transfer an erase library by library transfer (LibTrans) and then branch to flash erase (EraseFLASH).
5. In flash erase (EraseFLASH), set a clock frequency by erase initialization (EraseInit).
   Next, read in a command and if it’s a block erase, receive the erase data by erase data reception (GetEraseData) and erase a specified block by erase start (EraseStart).
   If the received erase data is an end of erase data, terminate the erase process.
6. In the memory read command, the address from which to read is specified by command read (GetCmdData). In memory read (ReadMemory), read memory contents from the user boot area and user area.
7. In the user boot area sum check and user area sum check commands, check the user boot area and user area for data integrity by sum check (SumCheck).
8. In the user boot area blank check and user area blank check commands, check the user boot area and user area for blank blocks by blank check (CheckBlank)
9. In the boot program status inquiry command, transmit the processing status of boot by program status (RequestBootPrgSts).

6. Sources of the Files for User Program Mode

The main sources of the files for user program mode are shown below.

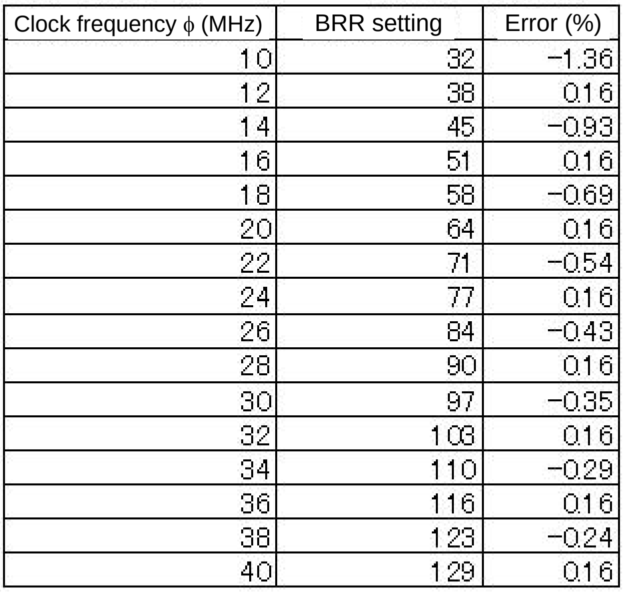
6.1 Header Files

The files for user program mode use the header files listed below.

(1) Bit rate setting (GenTest.h)
Sets a bit rate.

```
                                    /* RATE:9600/bps CLOCK:10MHz Main:x2 Peripheral:x2 */
#define MA_BRR_SCI                  0x40        /* Bit rate register channel 1 */
```

The user program mode is connected at 9,600 bps. For this reason, it is necessary that the bit rate register (BRR) value of the CSI module be set according to the operating clock frequency used. Here, since the clock frequency is 20 MHz (10 MHz × 2), MA_BRR_SCI is set to 64 (0x40) to obtain a bit rate of 9,600 bps. The relationship between the operating clock frequency and the set value of the BRR register when the bit rate = 9,600 bps is shown below.



Clock frequency ϕ (MHz)	BRR setting	Error (%)
10	32	−1.36
12	38	0.16
14	45	−0.93
16	51	0.16
18	58	−0.69
20	64	0.16
22	71	−0.54
24	77	0.16
26	84	−0.43
28	90	0.16
30	97	−0.35
32	103	0.16
34	110	−0.29
36	116	0.16
38	123	−0.24
40	129	0.16

After setting the value of MA_BRR_SCI appropriately to suit the board's operating clock frequency, build the source in the HEW to create an S type file of program.

(2) IO register definition (io7086.h)
Defines the SCI module and ROM related registers and bits and the PFC register.

```
/*************************************************************************/
/*    SH/7086F Internal I/O Include File                                 */
/*************************************************************************/
/*-----------------------------------------------------------------------*/
/*           SCI                                                                 */
/*-----------------------------------------------------------------------*/
/*                    CHANNEL 1                                                  */
/*-----------------------------------------------------------------------*/
#define SCI_SMR       (*(volatile unsigned char *)0xFFFFC080)
#define SCI_BRR       (*(volatile unsigned char *)0xFFFFC082)
#define SCI_SCR       (*(volatile unsigned char *)0xFFFFC084)
#define SCI_TDR       (*(volatile unsigned char *)0xFFFFC086)
#define SCI_SSR       (*(volatile unsigned char *)0xFFFFC088)
#define SCI_RDR       (*(volatile unsigned char *)0xFFFFC08A)

#define TE                            (unsigned char)0x20
#define RE                            (unsigned char)0x10
#define TE_RE                 (unsigned char)(TE | RE)
#define TDRE                  (unsigned char)0x80
#define RDRF                  (unsigned char)0x40
#define RDRF_ERR_CLR  (unsigned char)0x87
#define TEND                  (unsigned char)0x04

/*-----------------------------------------------------------------------*/
/*           FLASH                                                               */
/*-----------------------------------------------------------------------*/
/*                                                                               */
/*-----------------------------------------------------------------------*/
#define FCCS          (*(volatile unsigned char *)0xFFFFCC00)
#define FPCS          (*(volatile unsigned char *)0xFFFFCC01)
#define FECS          (*(volatile unsigned char *)0xFFFFCC02)
#define FKEY          (*(volatile unsigned char *)0xFFFFCC04)
#define FMATS                 (*(volatile unsigned char *)0xFFFFCC05)
#define FTDAR                 (*(volatile unsigned char *)0xFFFFCC06)

/*-----------------------------------------------------------------------*/
/*           PFC                                                                 */
/*-----------------------------------------------------------------------*/
/*                                                                               */
/*-----------------------------------------------------------------------*/
#define PACRL2                        (*(volatile unsigned short *)0xFFFFD114)
 #define PA4MD0                       (unsigned short)0x0001
#define PACRL1                        (*(volatile unsigned short *)0xFFFFD116)
 #define PA3MD0                       (unsigned short)0x1000
```

```
/*----------------------------------------------------------------------*/
/*                                                                                    */
/*----------------------------------------------------------------------*/
/*                                                                                    */
/*----------------------------------------------------------------------*/
#define FRQCR                   (*(volatile unsigned short *)0xFFFFE800)

/*----------------------------------------------------------------------*/
/*                                                                                    */
/*----------------------------------------------------------------------*/
/*                                                                                    */
/*----------------------------------------------------------------------*/
#define STBCR3                  (*(volatile unsigned char *)0xFFFFE806)
 #define MSTP12                 (unsigned char)0x10
```

(3) Macro definitions (FDTUMain.h, KAlg.h)
Defines the labels used in the program.

- FDTUMain.h

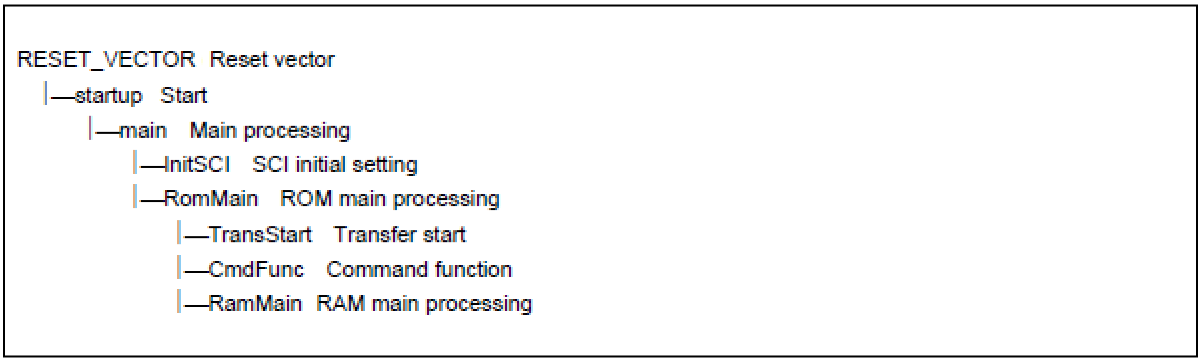
```
/* DEFINE */
enum {
        FmatsUserBootMat = 0xaa,
        FmatsUserMat = 0x00,
        WriteMode = 0x01,
        EraseMode = 0x01,
        FkeyEnable = 0xA5
};
```

- KAlg.h

```
/* DEFINES */
#define LOOP_END                        1
#define bufSize                         0x80
#define BLOCK_NO_ERROR                  0x09
#define ERASE_END                       0xFF
#define WRITE_END                       0xFFFFFFFF
#define ADDRESS_ERROR                   0x03
#define WRITE_ERASE_ENABLE              0x5A
```

6.2 Main Process and ROM Main Process

(1) Hierarchical module structure
The hierarchical structure of the main process and ROM main process modules is shown below.



```
RESET_VECTOR  Reset vector
  |—startup   Start
      |—main    Main processing
          |—InitSCI    SCI initial setting
          |—RomMain    ROM main processing
              |—TransStart    Transfer start
              |—CmdFunc    Command function
              |—RamMain   RAM main processing
```

Branch from the reset vector to start, set the stack pointer (Strt7086.src) and branch to the main process (GenTest.c, main).
In the main process, initialize the SCI (GetTest.c, InitSCI) to make it capable of transmission/reception, and branch to ROM main process (Ugenu.c, RomMain).
In the ROM main process, transfer RAM main process, etc. to the RAM (Ugenu.c, TransStart) and process the commands (Ugenu.c, CmdFunc). At end of data, branch to RAM main process (FDTUMain.c, RamMain).
The main process and the ROM main process are executed in the ROM.

(2) Reset vector (GenTest.c, GenTest.h)
The reset vector is shown below.

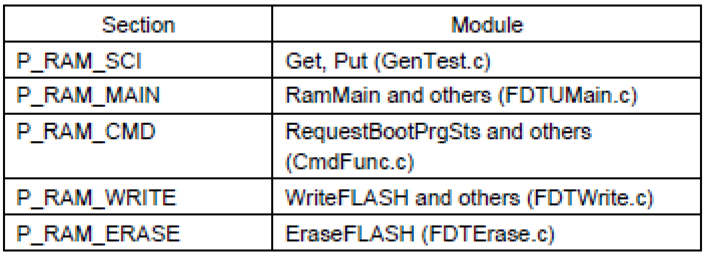
- GenTest.c

```
/*Declare the vector table*/
#pragma section _VECT
const DWORD RESET_VECTOR = (DWORD)RESET_JMP_ADDRESS;
#pragma section
```

- GenTest.h

```
#define RESET_JMP_ADDRESS          0x1000
```

(3) Transfer start (Ugenu.c, rom2ram.src)
In the transfer of RAM main process, etc., transfer the modules listed below from ROM to RAM according to the transfer table (rom2ram.src). The sections use the ROM option.



Section	Module
P_RAM_SCI	Get, Put (GenTest.c)
P_RAM_MAIN	RamMain and others (FDTUMain.c)
P_RAM_CMD	RequestBootPrgSts and others (CmdFunc.c)
P_RAM_WRITE	WriteFLASH and others (FDTWrite.c)
P_RAM_ERASE	EraseFLASH (FDTErase.c)

(4) Command functions (Ugenu.c, commands.h, CmdFunc.c, DeviceInfo.h)
The command function (CmdFunc) processes inquiries and the set commands. The commands are macro-defined (commands.h), and the processes (CmdFunc.c) corresponding to the respective commands are executed. For inquiry commands, the processes (CmdFunc.c, ReferFunc) that output the responses (DeviceInfo.h) corresponding to the commands are executed.

6.3 RAM Main Process

The RAM main process involves transferring a library, erasing the flash memory, and writing to the flash memory. These processes are executed in the RAM.

(1) Library transfer (FDTUMain.c)

- LibTrans

If commandID is prepareERASE (0x48), set FECS to EraseMode (0x01) and select the erase library. Otherwise (prepareUserAreaWrite, 0x43), set FPCS to WriteMode (0x01) and select the write library. Set FKEY to FkeyEnable (0xA5) to select Transfer and then set the SCO bit.

```
/*
//////////////////////
// LibTrans Function //
//////////////////////
*/
void LibTrans(BYTE commandID)
{
	if (commandID == prepareErase){
			FECS = EraseMode;
	}else{
			FPCS = WriteMode;
	}

	FKEY = FkeyEnable;

	ScoBitSet();
}
```

- ScoBitSet

Set the library transfer destination address in the FTDAR register, set the VBR register to 0x84000000, and set the SCO bit of the FCCS register to 1. There must be 4 or more of NOP instructions after the SCO bit setting.
To determine whether an error occurred during a transfer, write 0xFF to the first byte of library transfer destination address before performing a transfer and check that the address value is 0x00 after the transfer.

```
/*
///////////////////////
// ScoBitSet Function //
///////////////////////
*/
BYTE ScoBitSet(void)
{
        volatile BYTE i;
        WORD     work;
        void     **save_vbr;

        /* Transmission error check initialization */
        *((volatile BYTE *)TRANS_RAM_ADDR) = 0xFF;

        FTDAR = FTDAR_VALUE;

        save_vbr = (void **)get_vbr();
        set_vbr((void **)0x84000000);

        work = FRQCR;
        FRQCR = 0x36DB;

        FCCS |= 0x01;                                   /* SCO interruption */

/*      for(i=0; i < 2; i++);*/
        nop();
        nop();
        nop();
        nop();

        set_vbr(save_vbr);
        FRQCR = work;

        /* Transmission error check */
        if(0x00 == *((volatile BYTE *)TRANS_RAM_ADDR)) {
                return(NORMAL);                         /* Transmission normal end */
        }

        return(ABNORMAL);                               /* Transmission error */
}
```

TRANS_RAM_ADDR and FTDAR_VALUE are defined in KDevice.h as follows:

```
        /* SCO define */
        #define TRANS_RAM_ADDR          0xFFFF9000
        #define FTDAR_VALUE                     0x00    /* RAMTOP+0Kb */
```

(2) Area selection (FDTUMain.c)
To select the user boot area or the user area, set FmatsuUserBootMat (0xaa) or FmatsUserMat (0x00) in the FMATS register. There must be 2 or more of NOP instructions after the setting.

```
/*
/////////////////////////////
// UserBootSelect Function //
/////////////////////////////
*/
void UserBootSelect(void)
{
    volatile BYTE i;

    FMATS = FmatsUserBootMat;
    for(i=0; i < 1; i++);
/*
    nop();
    nop();
*/
}
```

```
/*
////////////////////////////
// UserMatSelect Function //
////////////////////////////
*/
void UserMatSelect(void)
{
    volatile BYTE i;

    FMATS = FmatsUserMat;
    for(i=0; i < 1; i++);
/*
    nop();
    nop();
*/
}
```

(3) Flash memory erase (FDTErase.c)

• EraseInit
Select the user area and after specifying the operating clock frequency, initialize the erase library. For the operating clock frequency, the operating clock frequency specified by FDT is transmitted to the device in new bit rate selection. The library initialization uses this operating clock frequency.

```
/*
////////////////////////
// EraseInit Function //
////////////////////////
*/
BYTE EraseInit(void)
{
    InitPtr ERASE_INIT = (InitPtr)INIT_ADDR;

    FKEY = WRITE_ERASE_ENABLE;
    return ((*ERASE_INIT)(Frequency,0));
}
```

• EraseStart
After specifying the block number to be erased, call the erase library. The block numbers are received from the Flash Development Toolkit. For details, refer to the sources of the files for user program mode.

```
/*
/////////////////////////
// EraseStart Function //
/////////////////////////
*/
BYTE EraseStart(BYTE blk_no)
{
    ErasePtr ERASE_BLOCK = (ErasePtr)WRITE_ERASE_ADDR;

    return ((*ERASE_BLOCK)(blk_no));
}
```

INIT_ADDR and WRITE_ERASE_ADDR defined in KDevice.h as follows:

```
    #define TRANS_RAM_ADDR          0xFFFF9000
    #define INIT_ADDR               (TRANS_RAM_ADDR+32)
    #define WRITE_ERASE_ADDR        (TRANS_RAM_ADDR+16)
```

(4) Flash memory write (FDTWrite.c)

- WriteInit

Select the user area and after specifying the operating clock frequency, initialize the write library.

```
/*
////////////////////////
// WriteInit Function //
////////////////////////
*/
BYTE WriteInit(void)
{
        InitPtr WRITE_INIT = (InitPtr)INIT_ADDR;

        FKEY = WRITE_ERASE_ENABLE;
        return ((*WRITE_INIT)(Frequency,0));
}
```

- WriteStart

After specifying the address where the data to write is stored and the address to which to write, call the write library.

The write data and the write destination address are received from the Flash Development Toolkit. For details, refer to the sources of the files for user program mode.

```
/*
/////////////////////////
// WriteStart Function //
/////////////////////////
*/
BYTE WriteStart(BYTE *data, DWORD adr)
{
        WritePtr WRITE_DATA = (WritePtr)WRITE_ERASE_ADDR;

        return ((*WRITE_DATA)((BYTE *)data, (BYTE *)adr));
}
```

- Execution of a write termination process (WriteFLASH)

This is part of the flash memory write termination process. For details, refer to the sources of the files for user program mode.
In write data reception (GetWriteData), receive the address where the data to write is stored and the address to which to write. If the write destination address is WRITE_END (0xFFFFFFFF), execute a write termination process.
Read out the write library.

```
/* Acquisition of command data   */
if (GetWriteData(pData, &pAddress, add_sum)){
        return;
}
if (pAddress != WRITE_END){
        /* A setup of boot status */
        BootStatus = MODE_WRITE_RUN;

        /* Program start */
        if (ErrorStatus = WriteStart(pData, pAddress)){
```

7. Programming Guide

This section explains how to write a program using the flash microcomputer’s standard boot program. A sample program and the precautions to take are described. For details, see the hardware manual.

7.1 Functional Outline

The microcomputer’s standard boot program is comprised of a transfer library, erase library and a write library. The functionality of the boot program is outlined below.

- Transfers the write library and erase library to a specified area of the RAM
- In initialization, specifies the operating clock frequency
- Specifies a block number to erase a block
- Specifies the data to write and the address to which to write before performing a write
- Selects the user boot area or user area

7.2 Control Registers and Control Bits

The following shows the library transfer and user boot area related control registers and control bits.

(1) Selecting the functionality
Use the FKEY register to select transfer and write/erase. Set the FKEY register to H'A5 to transfer the write/erase library, or H'5A to execute the write/erase process.

State	Value	Function
Transfer enabled	H'A5	Can transfer a library. Can write a value to the SCO bit.
Programming/erasing enabled	H'5A	Can program or erase flash memory.

(2) Starting a library download
To transfer a library, set the SCO bit (FCCS register bit 0) to 1.

State	Value	Function
Source program copy disabled	0	Does not download a library to RAM.
Source program copy enabled	1	Issues a request to download a library to RAM. H'A5 must be written to FKEY and execution in on-chip RAM must be in progress. The SCO bit is cleared to 0 when downloading is completed.

(3) Selecting a library
To select a library, set the corresponding bit in the FPCS or FECS register to 1.

Program to Be Transferred	Register	Bit Name	Bit
Programming program	FPCS register	PPVS bit	Bit 0
Erasing program	FECS register	EPVB bit	Bit 0

(4) Selecting the user boot area
To select the user boot area, set the FMATS register to H'AA.

State	Value	Function
User area selection	Other than H'AA	Selects the user area.
User boot area selection	H'AA	Selects the user boot area.

[Note] Selections switchable in only the RAM.

(5) Selecting the destination of transfer
Use the FTDAR register to set the RAM address to which a library is transferred. Unless address settings are correct, bit 7 of the FTDAR register is set to 1.

Transfer Destination Address	Setting	Function
RAM start address + 20 Kbytes	H'00	Sets the start address to download a program to H'FF9000.
RAM start address + 24 Kbytes	H'01	Sets the start address to download a program to H'FFA000.
RAM start address + 28 Kbytes	H'02	Sets the start address to download a program to H'FFB000.
RAM start address + 16 Kbytes	H'03	Sets the start address to download a program to H'FF8000.

7.3 Using the Libraries

This section explains how to use the libraries.

(1) Transfer

Follow the procedure below to perform a transfer.

1. Select the write library or erase library to transfer. For the write library, set the PPVS bit (bit 0) of the FPCS register to 1.
   For the erase library, set the EPVB bit (bit 1) of the FPCS register to 1.
2. In the FTDAR register, specify the transfer destination address in the RAM.
3. Set the FKEY register to H'A5 to enable a transfer.
4. To allow for the transfer result to be checked, set the first byte of the transfer destination address in the RAM to H'FF.
5. Set the VBR register to H'84000000.
6. Set the SCO bit (bit 0) of the FCCS register to 1. Insert 4 NOP instructions after the bit manipulation instruction.
7. A return value will have been set in the first byte of RAM, so check that the value is H'00.

(2) Erase

Follow the procedure below to perform an erase.

1. Call the erase initialization entry (transfer destination + 32 bytes) and set the operating clock frequency (R4).
   The processing result is set in the R0 register.
2. Set the FKEY register to H'5A to enable an erase/write.
3. Select the user boot area or the user area using the FMATS register. For the user boot area, set H'AA in this register; for the user area, set any value other than H'AA, e.g., H'00. Insert 2 NOP instructions after the FMATS setting.
4. Set an erase block number in the R4 register and call the erase entry (transfer destination + 16 bytes).
5. The processing result is set in the R4 register.

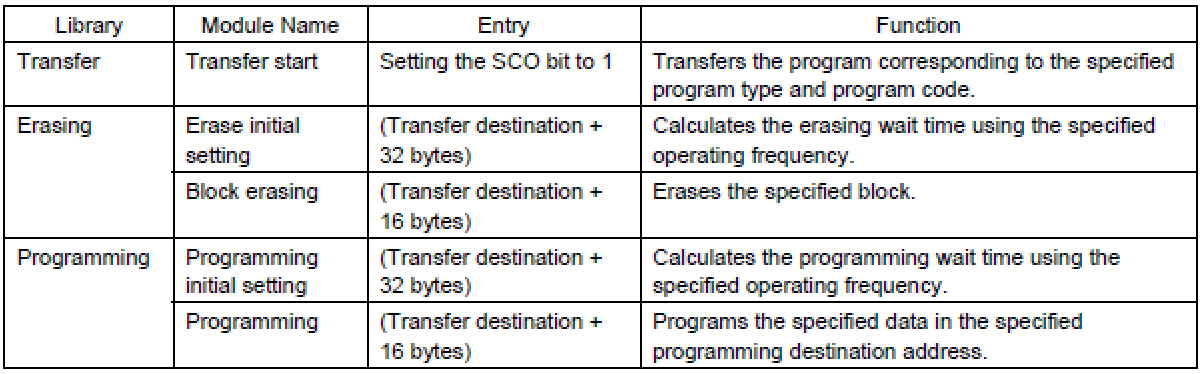
(3) Write

Follow the procedure below to perform a write.

1. Call the write initialization entry (transfer destination + 32 bytes) and set the operating clock frequency (R4).
   The processing result is set in the R0 register.
2. Set the FKEY register to H'5A to enable an erase/write.
3. Select the user boot area or the user area using the FMATS register. For the user boot area, set H'AA in this register; for the user area, set any value other than H'AA, e.g., H'00. Insert 2 NOP instructions after the FMATS setting.
4. Set the address of the write data in the R4 register and the write destination address in the R5 register, and then call the write entry (transfer destination + 16 bytes).
5. The processing result is set in the R4 register.
6. Call the write entry.

7.4 List of Module Facilities

There are three libraries: Transfer library, erase library and write library. The functionality of the respective modules are listed below.



Library	Module Name	Entry	Function
Transfer	Transfer start	Setting the SCO bit to 1	Transfers the program corresponding to the specified program type and program code.
Erasing	Erase initial setting	(Transfer destination + 32 bytes)	Calculates the erasing wait time using the specified operating frequency.
	Block erasing	(Transfer destination + 16 bytes)	Erases the specified block.
Programming	Programming initial setting	(Transfer destination + 32 bytes)	Calculates the programming wait time using the specified operating frequency.
	Programming	(Transfer destination + 16 bytes)	Programs the specified data in the specified programming destination address.

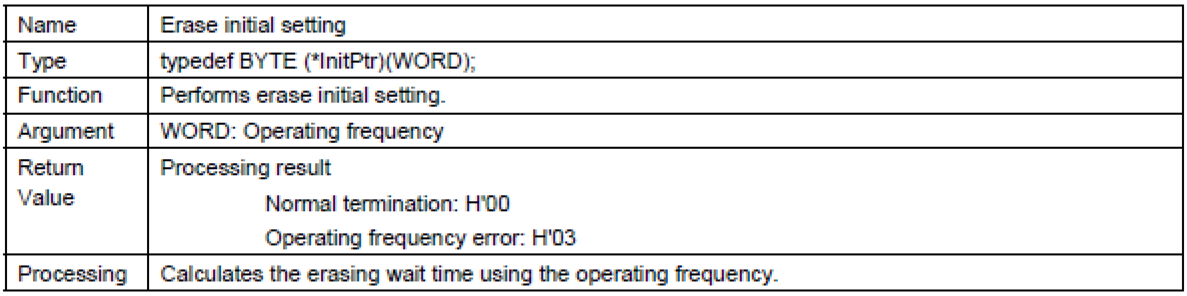
7.5 Module Specifications

Specifications of the library modules are shown below for reference.
For details, see the hardware manual.

(1) Transfer start

Name	Transfer start
Type	None Library is transferred by setting the SCO bit of FCCS register to 1.
Functionality	Program transfer
Parameter	None
Input	For the write library, the PPVS bit (bit 0) of the FPCS register is set to 1. For the erase library, the EPVB bit (bit 0) of the FECS register is set to 1. The transfer destination address of RAM is specified in the FTDAR register. The FKEY register is set to H'A5. The first byte of transfer destination address in RAM is set to H'FF. The VBR register is set to H'84000000.
Return value	None
Output	TDER bit (bit 7) of FTDAR register: Parameter check flag Terminated normally: 0 FTDAR register value abnormal: 1 (download is aborted) First byte of transfer destination address in RAM: Processing result Terminated normally: H'00 FKEY register value abnormal: H'03 Multiple selections error: H'05
Processing	Determines the library to transfer from the PPVS bit of FPCS register and the EPVB bit of FECS register If library selection is abnormal, returns from the module after setting the processing result Unless FKEY is H'A5, returns from the module after setting the TDER bit to 1 Transfers the library to the RAM address specified by FTDAR Clears the SCO bit to 0 Return to the instruction next to the one that set the SCO bit.

(2) Erase initialization



Name	Erase initial setting
Type	typedef BYTE (*InitPtr)(WORD);
Function	Performs erase initial setting.
Argument	WORD: Operating frequency
Return Value	Processing result Normal termination: H'00 Operating frequency error: H'03
Processing	Calculates the erasing wait time using the operating frequency.

(3) Block erase

Name	Block erasing
Type	typedef BYTE (*ErasePtr)(BYTE);
Function	Erases a block.
Argument	BYTE: Erase block number
Return Value	Processing result Normal termination: H'00 Erase block number error: H'09 FKEY error: H’11 Erasing error: H'21 Error protection: H'41
Processing	Checks FWE, FKEY, and block number. If an error occurs, sets an error code and returns control. Obtains the address using the block number. Erases the address corresponding to the block. If an erasing error occurs, sets an error code and returns control. Returns control at normal termination.

(4) Write initialization

Name	Programming initial setting
Type	typedef BYTE (*InitPtr)(WORD);
Function	Performs programming initial setting.
Argument	WORD: Operating frequency
Return Value	Processing result Normal termination: H'00 Operating frequency error: H'03
Processing	Calculates the programming wait time using the operating frequency.

(5) Write

Name	Programming
Type	typedef BYTE (*WritePtr)(BYTE *, BYTE *);
Function	Performs programming.
Arguments	BYTE * (first argument): Programming data storage address BYTE * (second argument): Programming destination address
Return Value	Processing result Normal termination: H'00 Programming data address error: H'03 Programming address error: H'05 FKEY error: H’11 Programming error: H'21 Error protection: H'41
Processing	Checks FWE, FKEY, and programming addresses. If an error occurs, sets an error code and returns control. Verifies and programs data. Verifies the programmed data. When there is no error, returns control. If there is an error, reprograms data. If the programming count is exceeded, returns control with a programming count error. When programming terminates normally, returns control.

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Revision Record

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